For engineers who design and manage the power and plant services

Power

AUGUST 1959 ONE DOLLAR

A McGRAW-HILL PUBLICATION

DESIGN AND EQUIPMENT APPLICATION

Locate pf capacitors for top savings 59
How rising fuel cost changes payout time . . 62
You can make scale models pay their way . . 65
What to expect from supervisory systems . . . 68
M-d turbine for that boiler-feed pump? . . . 71

DEPARTMENTS

Briefs on this month's nuclear happenings . . 76
Digests of latest engineering papers 86
Information center for new products 108
Marmaduke Surfaceblow's shovel job 146
A selective look at the power field 156

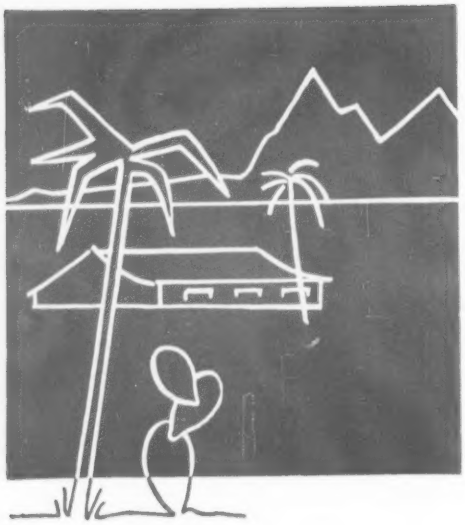
PLANT MAINTENANCE AND MANAGEMENT

How to train nuclear plant operators 183
Why automatic control for cooling towers? . 186
Quick answers to conveyor-belt problems . 188
Cut errors when measuring temperature . . 190
Practical pointers for using dry cells 192

Complete contents of this issue ▶ p 3

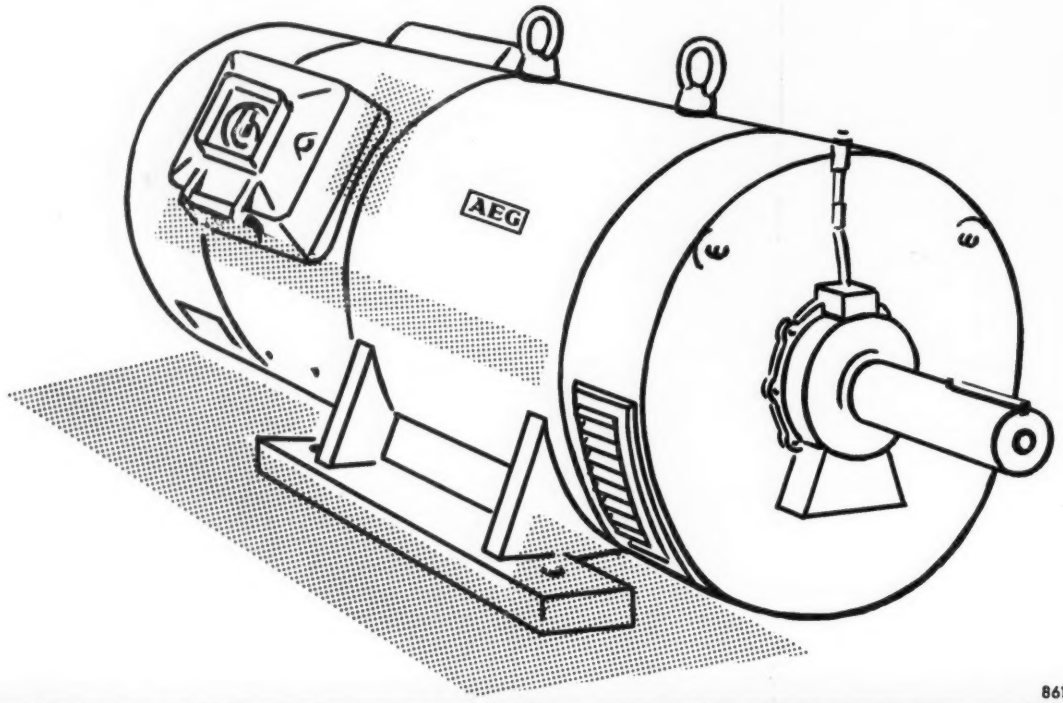
Thermal liquids a TD report . . . 53

AEG



Electricity can always be your helper regardless of whether a supply system is available or not.

AEG Self-Regulating Alternators without exciters, when powered by Diesel or other internal combustion engines, deliver electrical energy at practically constant voltage at all loads. These small power plants are of robust design, reliable in operation, and remarkable for their long life. They are being employed to an ever increasing extent for irrigation and water supply systems.



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Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

For more facts circle 201 on Reader Service card, p 97

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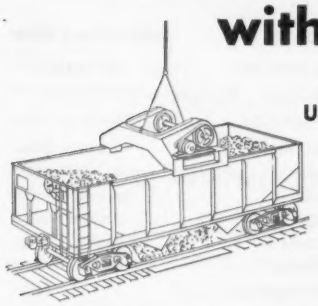
make the move

with LINK-BELT equipment



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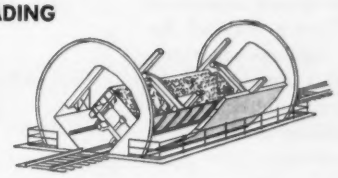
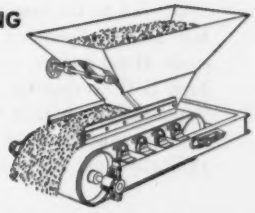


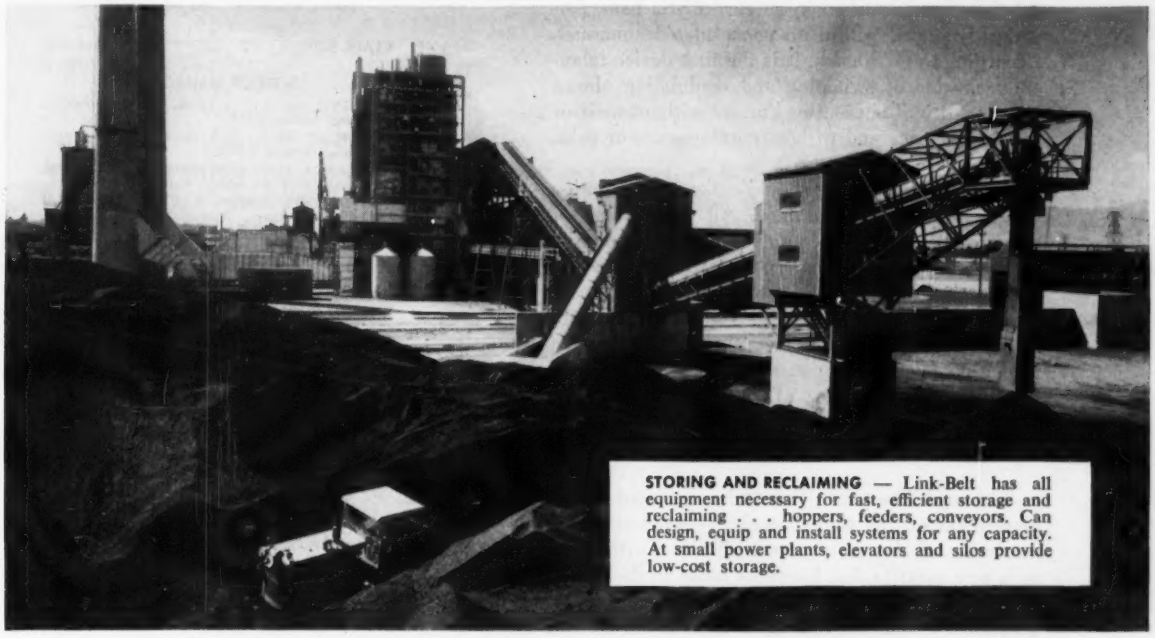
FEEDING



CAR SHAKERS are ideal for small or moderate capacity unloading. Low-frequency vibration is easy on cars . . . positive action cleans hopper-bottom cars fast.

ROTARY DUMPERS unload all types of open-top cars up to ninety-ton capacity. Cars are turned upside down and contents dumped in less than a minute.

FEEDERS for every use are available from Link-Belt. All assure uniformly controlled feed. Broad line includes belt, apron, screw and vibrating types.



STORING AND RECLAIMING — Link-Belt has all equipment necessary for fast, efficient storage and reclaiming . . . hoppers, feeders, conveyors. Can design, equip and install systems for any capacity. At small power plants, elevators and silos provide low-cost storage.

CENTRAL STATION OR SMALL BOILER HOUSE—Link-Belt has equipment for *every* coal handling job. We can furnish components or complete systems to match any capacity, any layout. And, if desired, we will work with your engineers and consultants from planning to erection of your system.

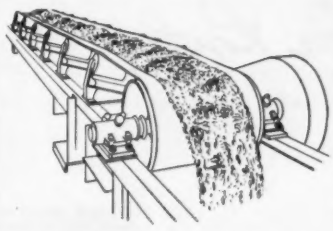
For full details, contact your nearest Link-Belt office. Ask for Book 2410—44 pages of coal handling equipment.

15,202

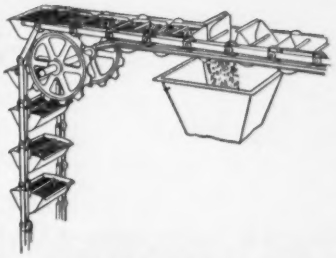
LINK-BELT

COAL HANDLING EQUIPMENT

DISTRIBUTING



BELT CONVEYORS move large tonnages at low cost—stock out, reclaim, distribute. Link-Belt also builds a full line of idlers, trippers, etc.



PECK CARRIERS elevate and convey in a continuous flow without transfers . . . can travel many combinations of vertical, horizontal, inclined paths.

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

For more facts circle 204 on Reader Service card, p 97

speaking of **Power**

Life and reliability of tomorrow's industrial electrical control equipment may have been even further improved as the result of a development announced last month. Speaking in New York's Waldorf Astoria Hotel before a group of business-paper editors, S R Ovshinsky, the youthful president of the 9-month old Ovitron Corporation, painted a verbal picture supplemented with working models of a radically new static switching device.

Inspired in part by a theoretical study of the metabolism and function of the individual human cell, the new device consists simply of two load-connected electrodes and a grid control element. All three are immersed in an electrolytic bath, permanently sealed within an encapsulated container. According to Ovshinsky, it is the first device inherently capable of switching and modulating almost any quantity of alternating current without wear or loss in efficiency and without moving parts or coils.

This simple device should make a contribution to the industrial-control field. All it requires for triggering is a small energy stimulus introduced through the grid element. Grid action makes the semipermeable surfaces of the two power electrodes bcome permeable to certain ions and thus the path between electrodes instantaneously changes from an insulating to a conductive state. This device could simplify maintenance of tomorrow's control schemes, and its inherent simplicity will also make it appealing to circuit designers.

Through the years POWER has reported on the semiconductors as they bowed in—selenium, germanium and the more recent silicon. Further, as each new contribution found its niche in the broad electrical power scheme, we reported that too. For additional details on this latest control device, the *Ovitron*, see the September issue.

Lon Rowley

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In Power this month

AUGUST 1959 • VOL. 103 • NO. 8 • 77TH YEAR

Editorial: Machine tools and kilowatts ____ 49

DESIGN AND EQUIPMENT APPLICATION

A *TD* report: Thermal liquids bid for process heating jobs ____ 53
Locate your power-factor capacitors where they'll save the most dollars ____ 59
How rising fuel cost changes heat-recovery equipment payout time ____ 62
Do scale models of plant or equipment designs pay their way? ____ 65
What you can do with modern supervisory systems ____ 68
Advantages of turbine-driven boiler-feed pumps—No. 8 in m-d turbine series ____ 71

DEPARTMENTS

Nuclear notes: News briefs on the latest developments ____ 76
Comment: Two pages reserved for readers' remarks ____ 78
Data sheet: Piping insulation weights per linear foot—double layer ____ 82
Technical briefs: Digests of latest engineering papers for busy power men ____ 86
New literature: Yours simply for mailing postage-free Reader Service card ____ 98
Equipment design of the month: Now, a propane-air peak-shaving mixing unit ____ 108
Plant equipment news: Your information center for new products and materials ____ 110
Thermo refresher: The turbine—a versatile prime mover ____ 136
Marmaduke Surfaceblow tells about his experiences as a steam-shovel operator ____ 146
Powerscope: A selective look at this month's power-field happenings ____ 156
Reports from the field ____ 158 *Calendar of events* ____ 162
Appointments ____ 166 *Engineers' bookshelf* ____ 172
George Edwards comes up with a study idea worth thinking about ____ 178

PLANT MAINTENANCE AND MANAGEMENT

Need grows for training programs aimed at nuclear-plant operators ____ 183
Here's why you should switch to automatic control of cooling-tower water ____ 186
Operators' notebook: Quick answers to common conveyor-belt problems ____ 188
Tips to help you reduce errors in your temperature measurements ____ 190
Plant electrical fact file: Some pointers on dry cells ____ 192
Plant problems: Here's how *Power* readers tackle them ____ 194
Practical ideas to keep your plant running at peak efficiency ____ 198

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Gas Tempering: **Report No. 1**

Electric Utilities Find Safe Superheater

Metal Temperatures Across Width of Superheaters of Typical B&W Boilers with Gas Tempering

BOILER No. 1

Average Metal Temperature	1040 F	
Deviation		±40F

BOILER No. 2

Average Metal Temperature	1035 F	
Deviation		±50F

BOILER No. 3

Average Metal Temperature	1125 F	
Deviation		±45F

Gas Tempering Assures Tube Temperatures

Longer Tube Life
Less Superheater Maintenance
Need For High Alloys Minimized

The ideal gas temperature to which superheater tubes should be exposed is the lowest temperature that will provide the required superheat and reheat with a reasonable amount of surface. If this temperature is exceeded in order to make a larger proportion of the total heat released in the furnace available for superheating and reheating, alloy requirements are increased and there is greater danger of superheater tube failure.

Now, the required heat can be delivered to the superheater *without exceeding desired metal temperatures* by the use of Gas Tempering.

Gas Tempering—is the reintroduction of cool flue gases near the furnace outlet to control the temperature of the furnace gases entering the superheater. It allows you to control furnace exit gas temperatures under all operating conditions.

Definitive Booklet: If you'd like to learn more about the economies and design flexibility available to you through Gas Tempering, write for Bulletin G-96. Address: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

Major Advantages of B&W Gas Tempering

. . . It cuts overall plant costs because the smaller size unit requires a smaller building per kw, a lighter foundation, less structural steel and shorter steam leads.

. . . It enables you to utilize the most economical available fuels. It permits the burning of a variety of coals without slagging, minimizes external corrosion of superheater tubes, and assures safe metal temperature, thus prolonging tube life, regardless of the fuel fired.

. . . It provides safe superheater tube temperature by positive gas temperature control; it protects superheater during startup and under all operating conditions.

. . . It makes it safer to design for economies offered by operation at steam temperatures of 1050 F and above.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-936

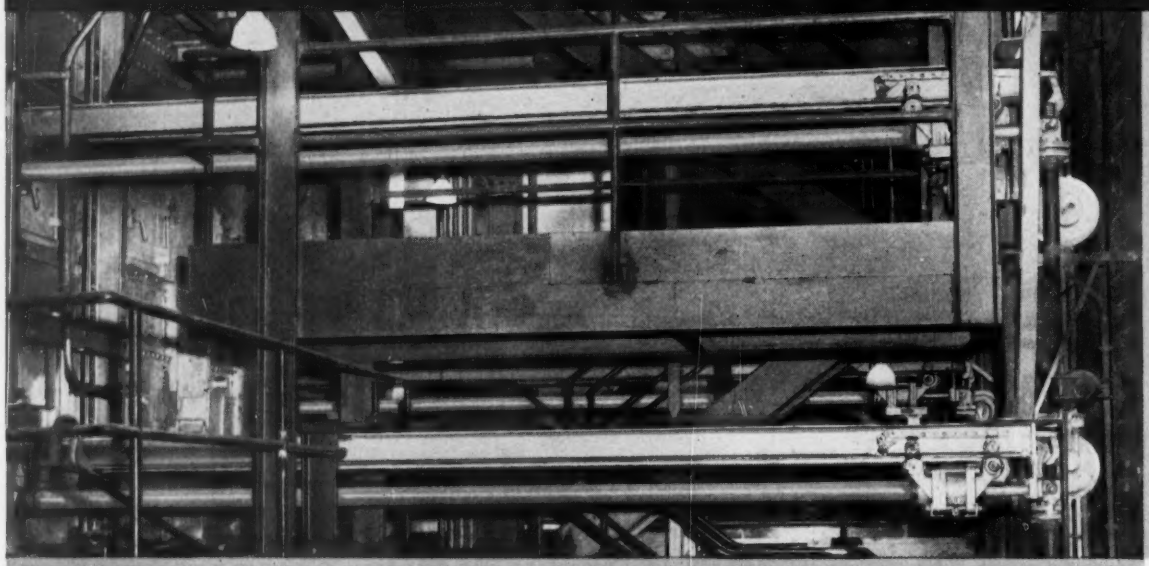
For more facts circle 205 on Reader Service card, p 97

AT F.M. TAIT STATION, DAYTON POWER & LIGHT CO.

BOILER CLEANING IMPROVEMENT HELPS MODERNIZATION PROGRAM

SAVE $40,000

DIAMOND BLOWERS and AUTOMATIC



Three of the Diamond Model IK Long Retracting Blowers installed to replace manually operated rotary blowers. Electric motor driven, they are controlled by the Automatic Sequential Panel. Air is used as the blowing medium. Rotary elements were retained in cooler locations and motorized for automatic operation and are also controlled by the Automatic Sequential Panel.

In the continuous struggle to cut operating costs, the Dayton Power & Light Co. has found a very useful tool in "Boiler Cleaning Modernization."

By applying the latest soot blowing equipment to four of their boilers at the F. M. Tait Station, together with other features of the modernization program, the Dayton Power & Light Co. was able to reduce the operating costs on these boilers by some $40,000 per year and also cut blower maintenance costs.

On the first boiler that had its cleaning modernized, 17 rotating elements were removed; the remaining seven blowers of this type were electrified for automatic control. The cleaning equipment added consisted of five Long Retracting Blowers and six Short Retracting Blowers. All blowers are automatically controlled by a Diamond Selectromatic Panel.

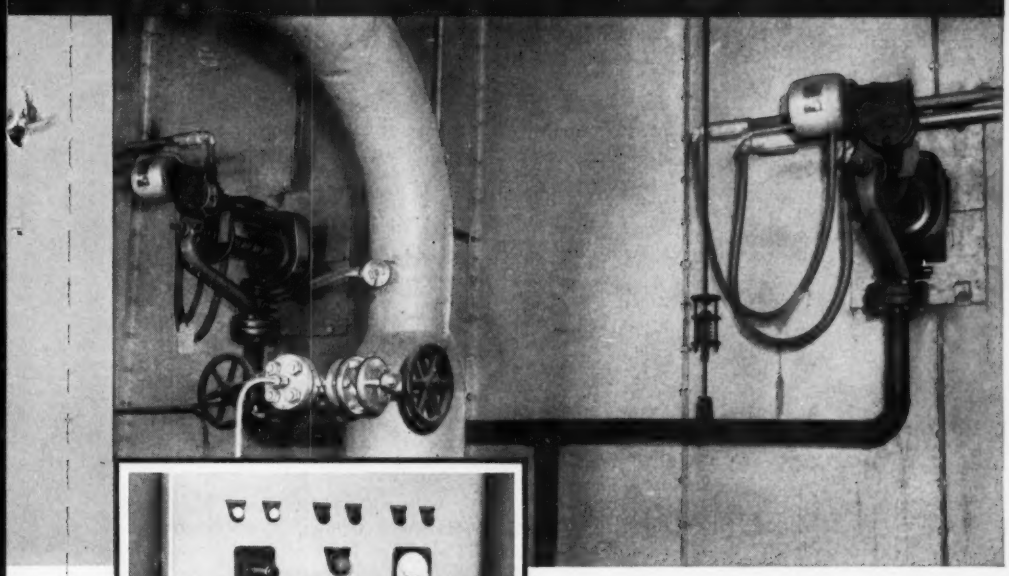
This is one of many examples of the savings possible by improvements now available in Diamond Blowers and Automatic Sequential Control. Over the years Diamond has engaged in continuous aggressive research in boiler cleaning. This research has paid off in improvements that save you money and improve your operation.

Let us make a study of your boiler cleaning . . . perhaps similar savings can be suggested.

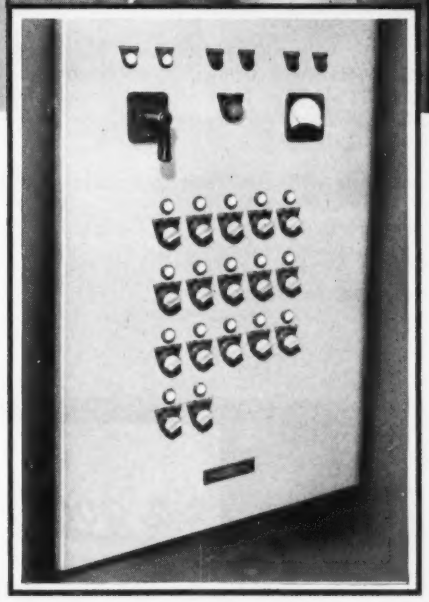
Per Year in Operation

and Cut Blower Maintenance Costs

SEQUENTIAL CONTROL PANEL



Two of the air blowing Model IR short retracting wall blowers with electric automatic operation.



Diamond Automatic Sequential Control Panel installed as part of the modernization program at the F. M. Tait Station. This panel automatically operates each blower in turn until the blowing cycle is complete. Any individual blower may be operated independently by simple turning switches. Cleaning program is set up by switches. Operator starts — thenceforth operation is automatic.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

8243

DIAMOND SPECIALTY LIMITED • WINDSOR, ONTARIO

For more facts circle 206 on Reader Service card, p 97

WELBOND®

is the valve for high pressures, high temperatures

Yarway Welbond Valves are available in 9 sizes, ¼" to 2½", angle and straightway designs. Pressures to 2500 psi, temperatures to 1500° F.

Welbond is the valve designed by Yarway specifically to provide modern steam power plants with the ultimate in high pressure, high temperature valve service.

These special Welbond features insure improved valve performance:

- **Stem** of 321 stainless steel, used with special **packing** to prevent stem corrosion
- Easy and quick **accessibility.** All working parts removable through yoke.
- Non-distorting, thermally-compensated **seat**
- Ventilated, easy grip **handwheel**
- **Streamlined flow** through body

Welbond Valves are winning approval on superheater vents and drains, water wall drains, economizer drains, steam gage shut-off, strainer blow-off and many other steam plant services. Your Yarway man will be glad to discuss applications for your plant.

For full information, write for Yarway Bulletin B-452.

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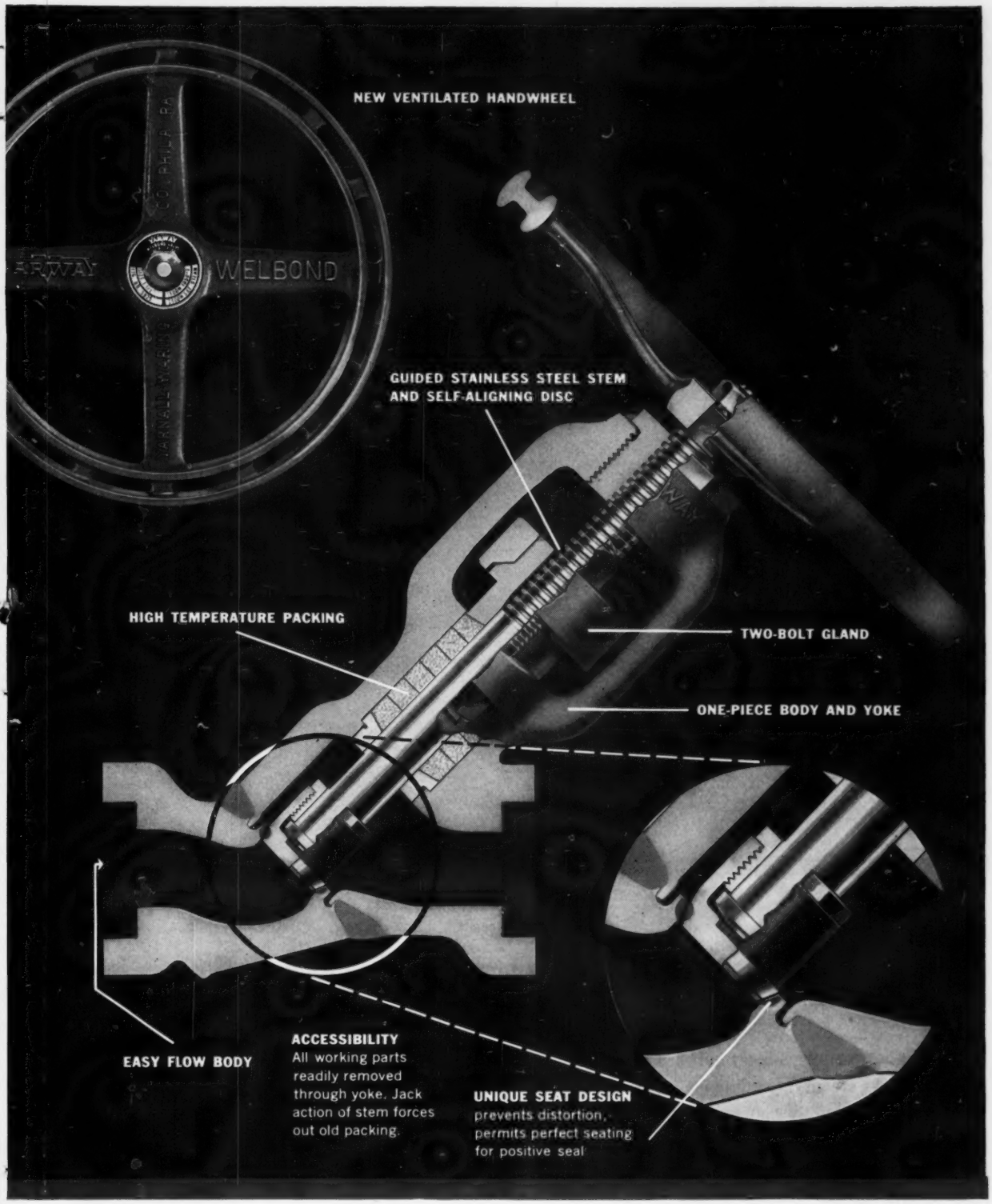
YARWAY

WELBOND : · a good


NEW VENTILATED HANDWHEEL
WELBOND
GUIDED STAINLESS STEEL STEM AND SELF-ALIGNING DISC
HIGH TEMPERATURE PACKING
TWO-BOLT GLAND
ONE-PIECE BODY AND YOKE
EASY FLOW BODY
ACCESSIBILITY
All working parts readily removed through yoke. Jack action of stem forces out old packing.
UNIQUE SEAT DESIGN
prevents distortion, permits perfect seating for positive seal

way to specify high pressure/high temperature valves

For more facts circle 207 on Reader Service card, p 97

How Bailey makes steam

Fingertip Controls, convenient indicators, and trend recorders make steam control room operating duties a pleasure. You get this bonus for your operators when you specify Bailey Meters and Controls.

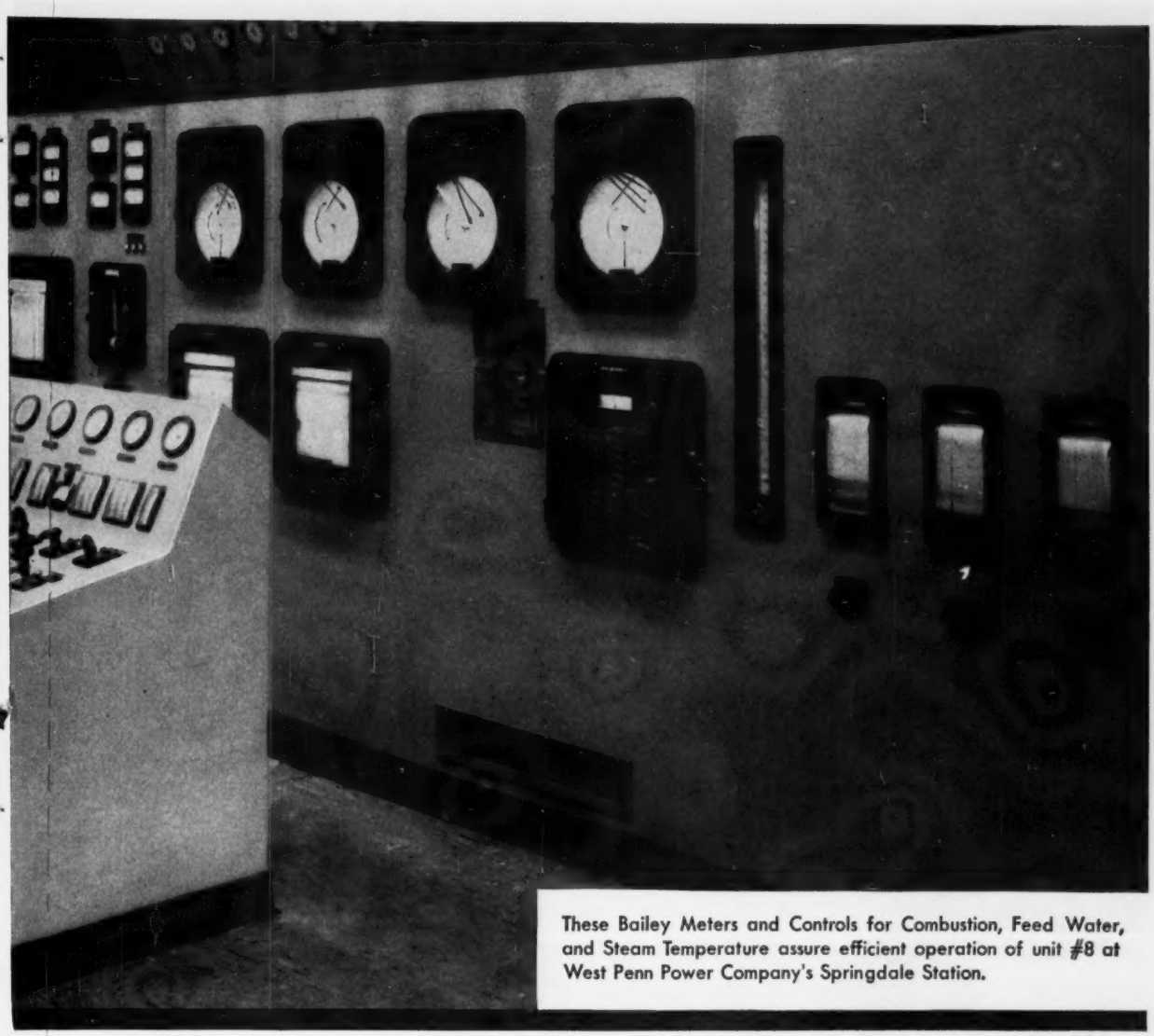
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



These Bailey Meters and Controls for Combustion, Feed Water, and Steam Temperature assure efficient operation of unit #8 at West Penn Power Company's Springdale Station.

operating duties a pleasure

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A133-2

BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

10 36 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

For more facts circle 208 on Reader Service card, p 97

Eddystone Station's Unit 1 has a capacity of 2,000,000 lb/hr at 5000 psig and 1200°/1050°/1050°/F . . . uses C-E Sulzer Monotube Steam Generator.

Vulcan Selective-Sequence system provides Eddystone Station with precision soot blowing

When Unit 1 of Philadelphia Electric's Eddystone Station goes into operation, a Vulcan Selective-Sequence system will accurately control all soot blowing.

Selective-Sequence systems were chosen for both units 1 and 2 at this super-critical station because they assure positive, dependable boiler cleaning . . . make the most efficient use of the blowing medium.

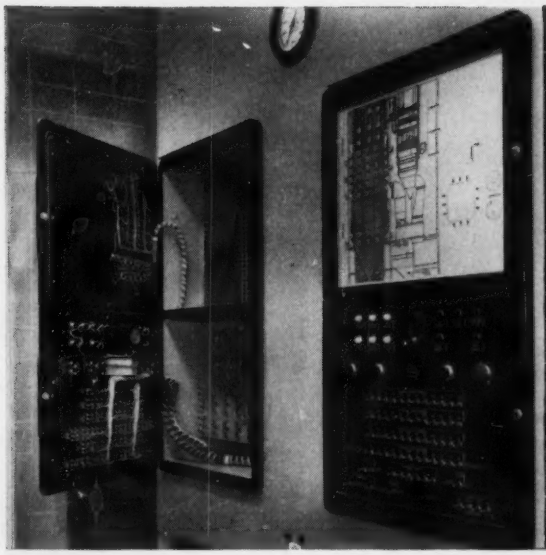
Vulcan Controller saves time. Without leaving the panel, the operator pushes a master button to place the system in sequential operation. He can see that each soot blower is operating in sequence for the proper interval with adequate pressure. He can modify the sequence to improve cleaning or conserve the blowing medium without time-consuming wiring and piping changes.

Vulcan long retractables speed cleaning. With dual-motor drive, Eddystone's T-30's clean uniformly; minimize the danger of tube cutting or erosion. Low rotating speed increases range and penetration of cleaning, decreases wear, eliminates whip, and permits proper cleaning with faster traversing speeds.

Half-'tracts with 19-foot travel, wall deslaggers, and air pre-heater controls are also used.

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY, ERIE 4, PA.

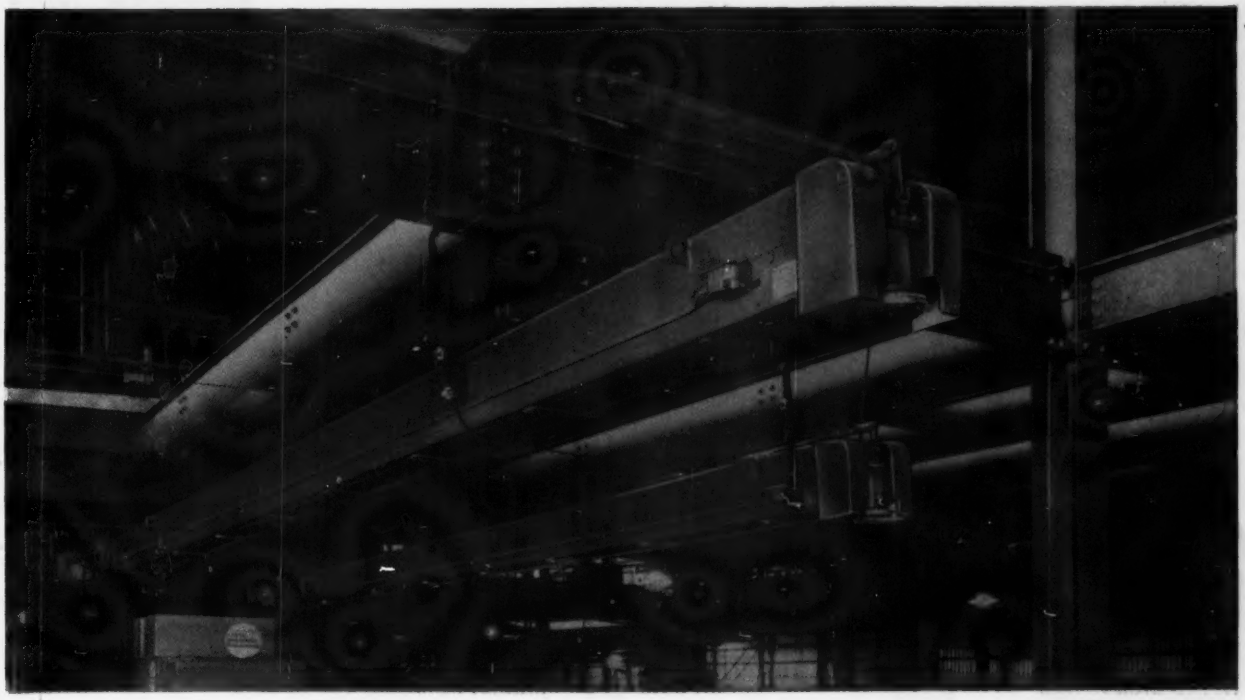
BLAW-KNOX



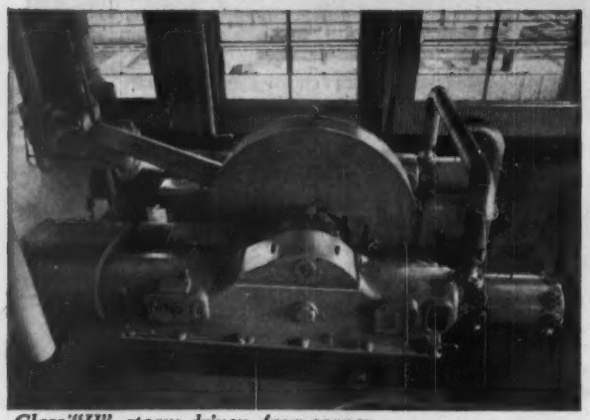
Panel provides centralized control of soot blowing at Eddystone. With the Vulcan SSC-120 Selective-Sequence controller, each blower can be operated four times during a schedule, or there can be four different schedules. The sequence can be varied by means of a jack board. Any soot blower can be operated at any point in the sequence by plugging one end of a patch cord into the blower jack, and the other end into the desired sequence jack. Write for Bulletin 1029.

Wall deslagger conserves steam generated at Eddystone by three special package boilers. High striking power of Vulcan RW-3E drives off gummy masses to assure high heat-transfer capacity, and uniform superheat and reheat temperature control. Dual motors are used: one speeds the nozzle to and from the blowing position, the other rotates it slowly for thorough cleaning. All parts are covered for protection, assuring long life with low maintenance. Write for Bulletin 1034.

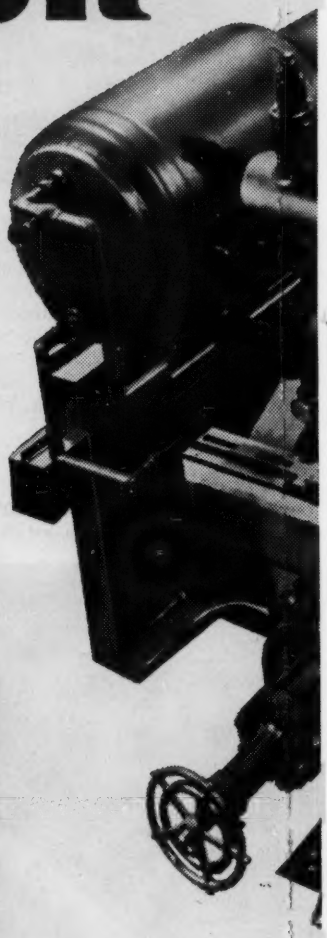
Vulcan T-30's have 30- and 37-foot travels. Motors are mounted at the boiler end to facilitate maintenance, yet away from heat of the boiler wall. Their placement avoids interferences. Write for Bulletin 1030.

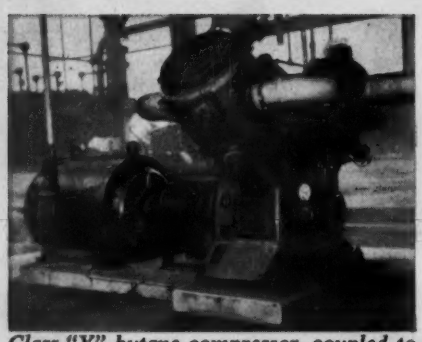


FOR EVERY PROCESSING REQUIREMENT THERE'S A CP COMPRESSOR MADE JUST FOR THE JOB

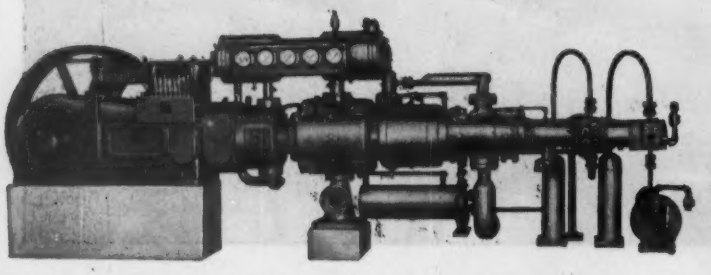


Class "H", steam-driven, four-corner, single-stage hydrocarbon gas booster.

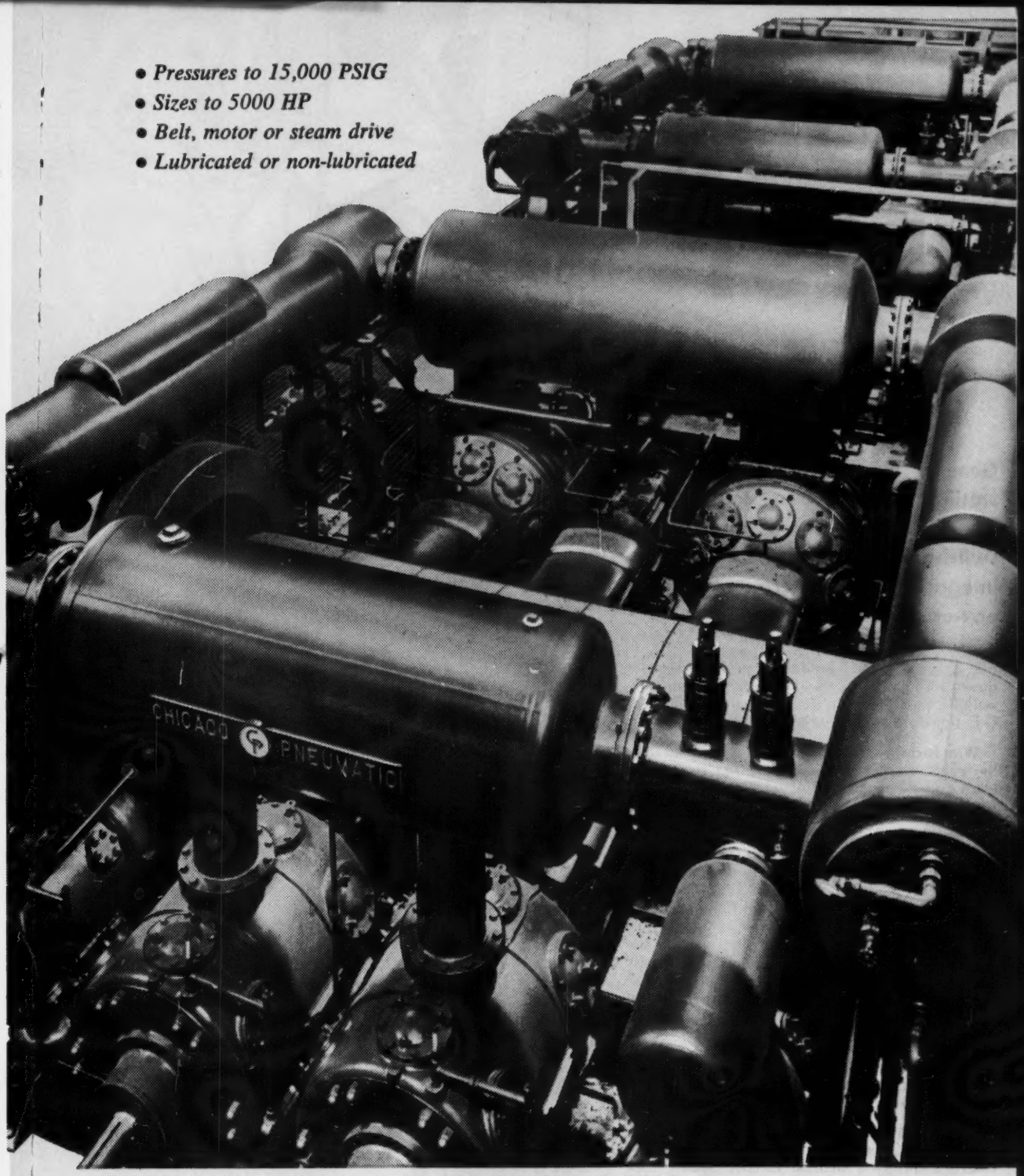




Class "Y" butane compressor, coupled to an explosion-proof motor. In service in a large refinery.



Class "T", horizontal, straight-line, five-stage helium compressor. 6000 psig; 100 hp size.



Two Class "FE" balanced-opposed compressors in process work. 3500 hp; five-stage.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

YOUR BEST BUY

General Electric Master Unit Substations are your best "total value" buy—most advanced transformer, switchgear designs . . . completely integrated for modern, economical power distribution.

For a "total value" product appraisal, consider these over-all advantages of factory-built unit substations, then factor in the product superiority of G-E transformer and switchgear components.

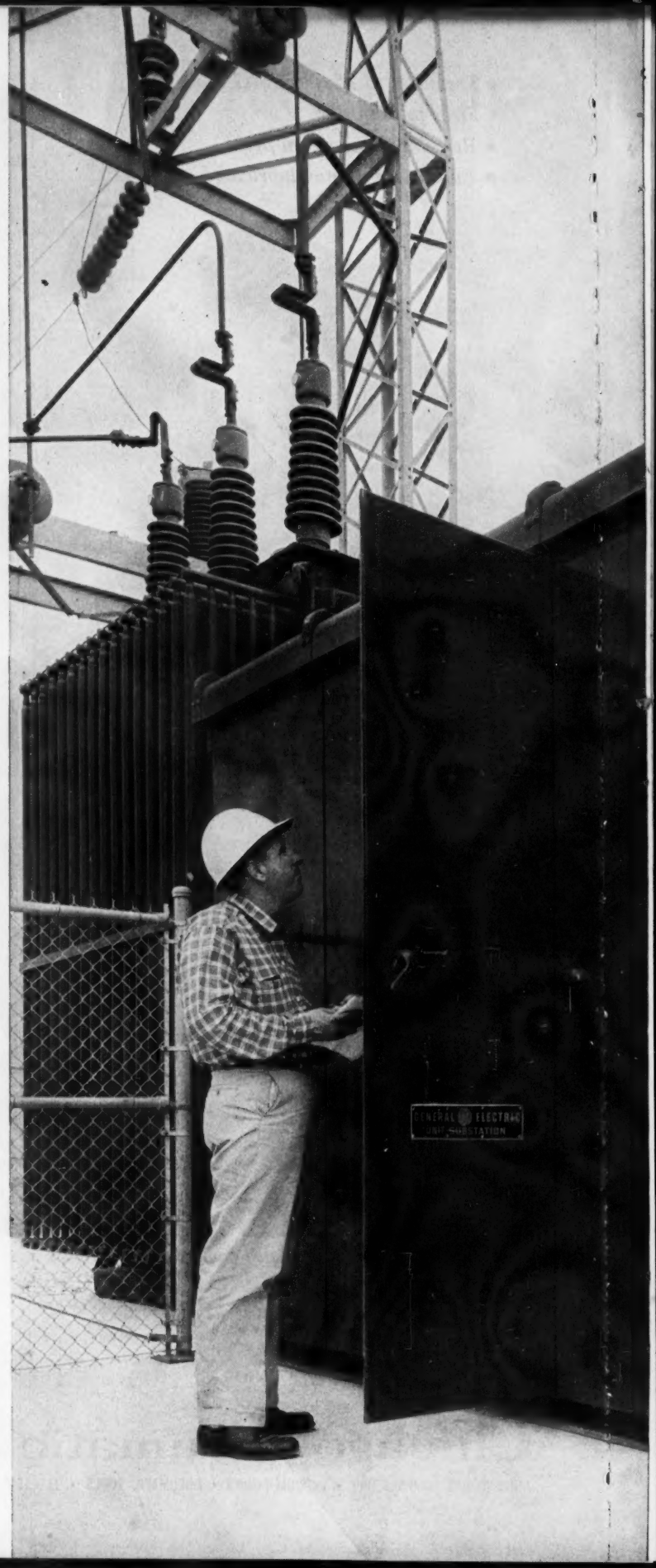
With factory-built substations, you benefit from the work of G-E's expert engineering staff which takes over the detail jobs of substation design and frees your engineers for other projects.

Centralizing responsibility with General Electric assures you of a thoroughly integrated, modern product, like the unit substation shown at the right which supplies the entire electrical load for the new United States Gypsum Company plant at Galena Park, Texas. Single billing against one order number means simplified cost control. Coordinated shipment results in quicker, less-costly installation. Factory-built unit substations make possible a building-block approach to low-cost expansion.

Unit substations have been accepted as community "good neighbors" because they are attractive, compact, easy to landscape, and have low noise levels.

After you make the basic determinations of station arrangement, subtransmission and feeder voltages, specify a General Electric Master Unit Substation for the best "total value" buy for your distribution system investment. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y.

512-32

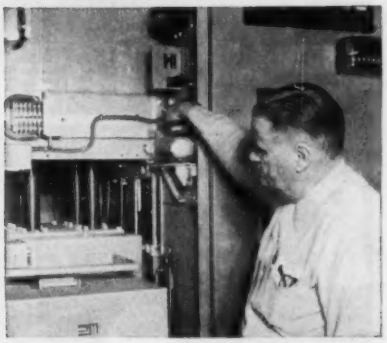


Progress Is Our Most Important Product

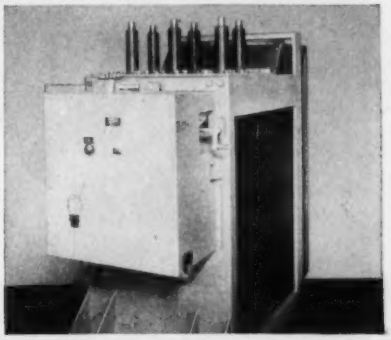
GENERAL ELECTRIC

circle 211 on Reader Service card, p 97

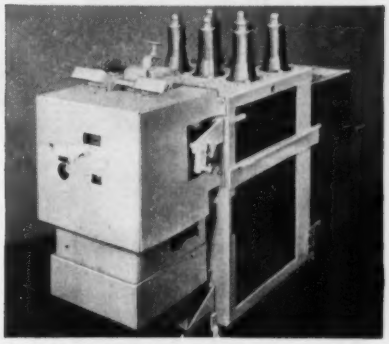
These switchgear features are part of G-E Unit Substation value



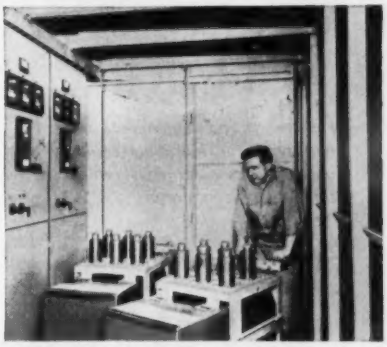
VERTICAL-LIFT DESIGN makes inspection, maintenance safer. Operators can actually see when primary disconnects are parted.



FIRST 1000 MVA BREAKER was developed to meet need for increased interrupting capacity. It makes G-E line most complete in industry.

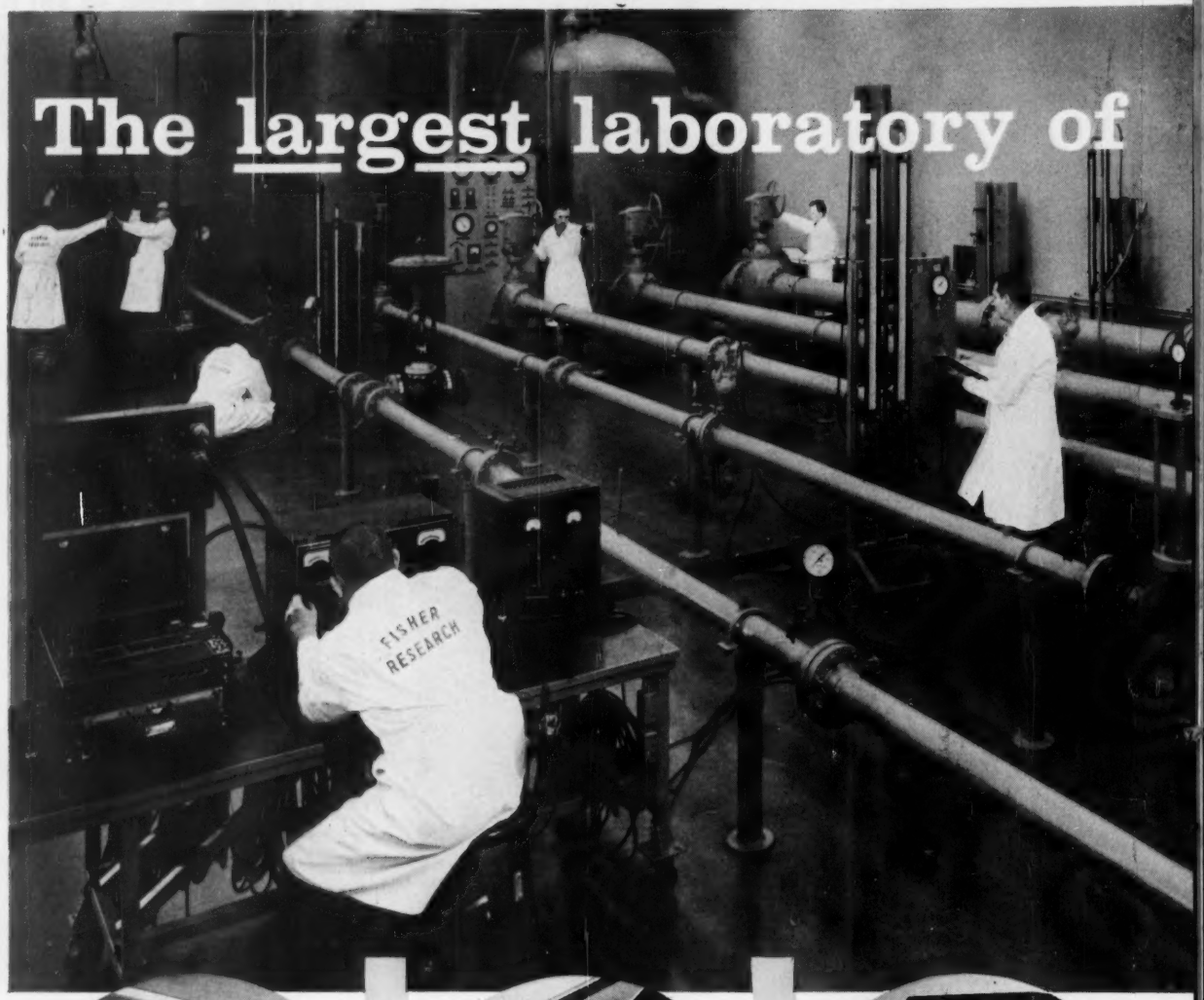


TWO-CYCLE BREAKER offers benefit of reduced line burning during fault, better coordination with other distribution protective devices.

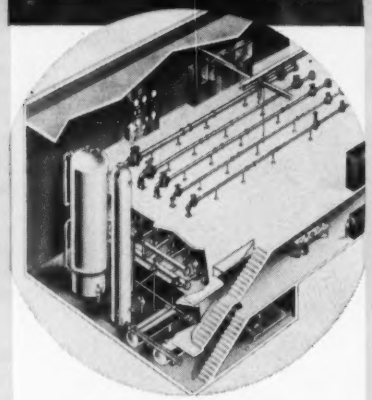


PROTECTED AISLE permits maintenance—indoors—in any kind of weather. An optional feature, the protected aisle is shipped factory-assembled.

The largest laboratory of



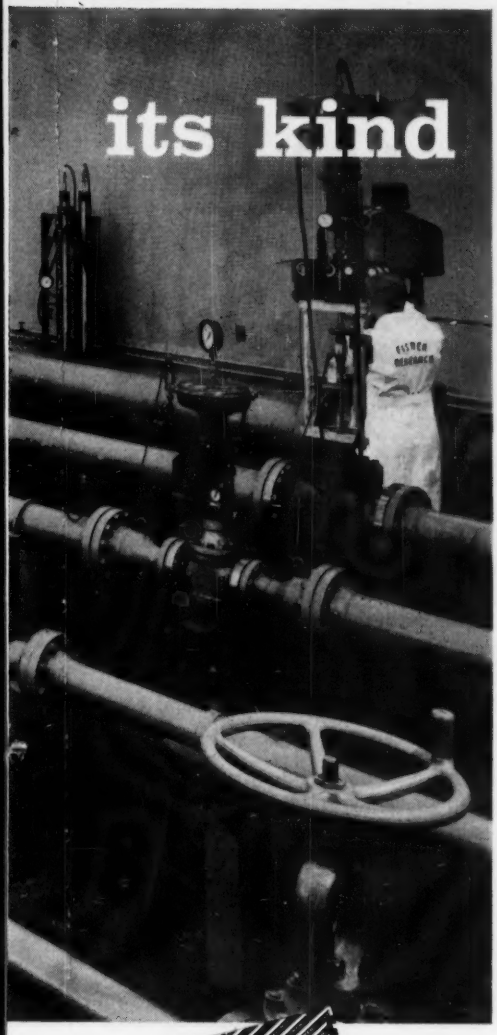
Flowmeters and manometers are just two types of precision equipment used for accurate measurement in this unique laboratory.



Three full stories are devoted to testing and proving the quality of all Fisher equipment.

A Fisher engineer obtaining frequency response data of Fisher equipment under test on an oscillograph.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...



its kind in the world

where research engineers develop and perfect the quality of Fisher products

THIS is a remarkable facility. It's the nerve center of a 3-story laboratory built to duplicate every conceivable field condition under which any Fisher product might operate. There's no other like it, anywhere. The engineers shown are keeping keen observation on the operating characteristics of such Fisher equipment as pressure regulators, liquid level controls, diaphragm control valves . . . plus many other types. There are literally hundreds of these complex and abnormally rigid tests which Fisher controls are subjected to before they are released to the user.

QUICK FACTS ABOUT THE FISHER LABORATORY

- It is equipped with vessels capable of storage pressures up to 2500 psig. These vessels discharge into five flow metering lines ranging in size from 4 inches to 12 inches.
- It is possible to test with either air or water at 400 psig pressure. One 4-inch line is capable of 2500 psig pressure for air or water testing.
- All flows are metered with orifice plates and differential manometers. Liquid flows can be metered up to 6000 GPM and gas flows up to 7,000,000 SCFH.
- Actual flow test curves are recorded on each Fisher valve design. This gives a visual record of the operating characteristics of each piece of Fisher equipment and proves that its performance in the line will precisely match published data.
- It is an approved laboratory for determining official ASME capacity ratings on safety and relief valves used on unfired pressure vessels.

The end result of these combined facilities and constant vigilance is the building and maintenance of user confidence . . . so that when an instrument man says "put a Fisher in the line" he knows that it will perform as promised and guaranteed.

Send for Bulletin AL-8

This comprehensive booklet contains valve sizing and capacity charts obtained from thousands of actual laboratory flow tests for all Fisher body types and inner valve styles.

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT CO., CORAOPOLIS, PENNSYLVANIA

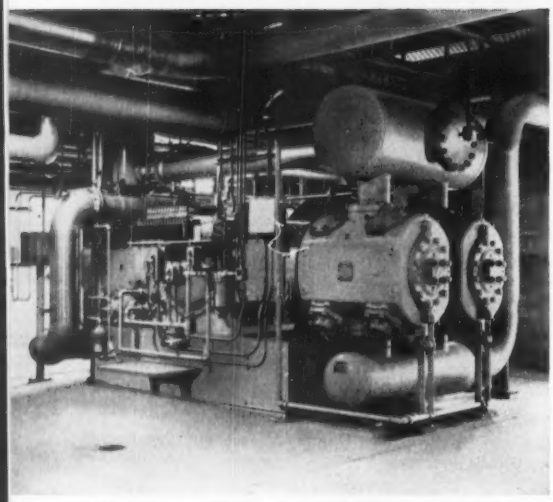
FISHER® Controls

SINCE 1880

For more facts circle 212 on Reader Service card, p 97

Specifies AIR for furnace and tube bank

. . . another installation of Cooper-Bessemer compressors for soot blowing service



Typical installation of Cooper-Bessemer FM air compressors for soot blowing service—El Segundo Station of Southern California Edison Company. This unit is rated 500 hp at 400 rpm.

On the banks of the Wabash, the new Breed Station of Indiana & Michigan Electric Company will stand out as a symbol of sound, far-sighted engineering. Designed by and built under supervision of the American Electric Power Service Corporation, this 450 megawatt steam generating station will embody the latest advances in power plant methods and equipment. Take furnace and tube bank cleaning for example . . .

The Cyclone-fired furnace of this modern station will be cleaned by compressed air. Three 600 hp Cooper-Bessemer Type FM compressors will deliver a total of 6100 cfm for soot blowing service.

One after another, power companies and their consultants are specifying this improved method of boiler cleaning as the solution to many problems. And for authoritative advice and the latest in facilities, they are turning to Cooper-Bessemer. Soot blowing is one of the many fields in which Cooper-Bessemer is able to render an outstanding service. Write for complete details.

BRANCH OFFICES: Grove City • New York • Chicago • Washington • San Francisco • Los Angeles • Houston • Dallas • Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis • Kansas City • Minneapolis • New Orleans • Shreveport

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GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

For more facts circle 213 on Reader Service card, p 97

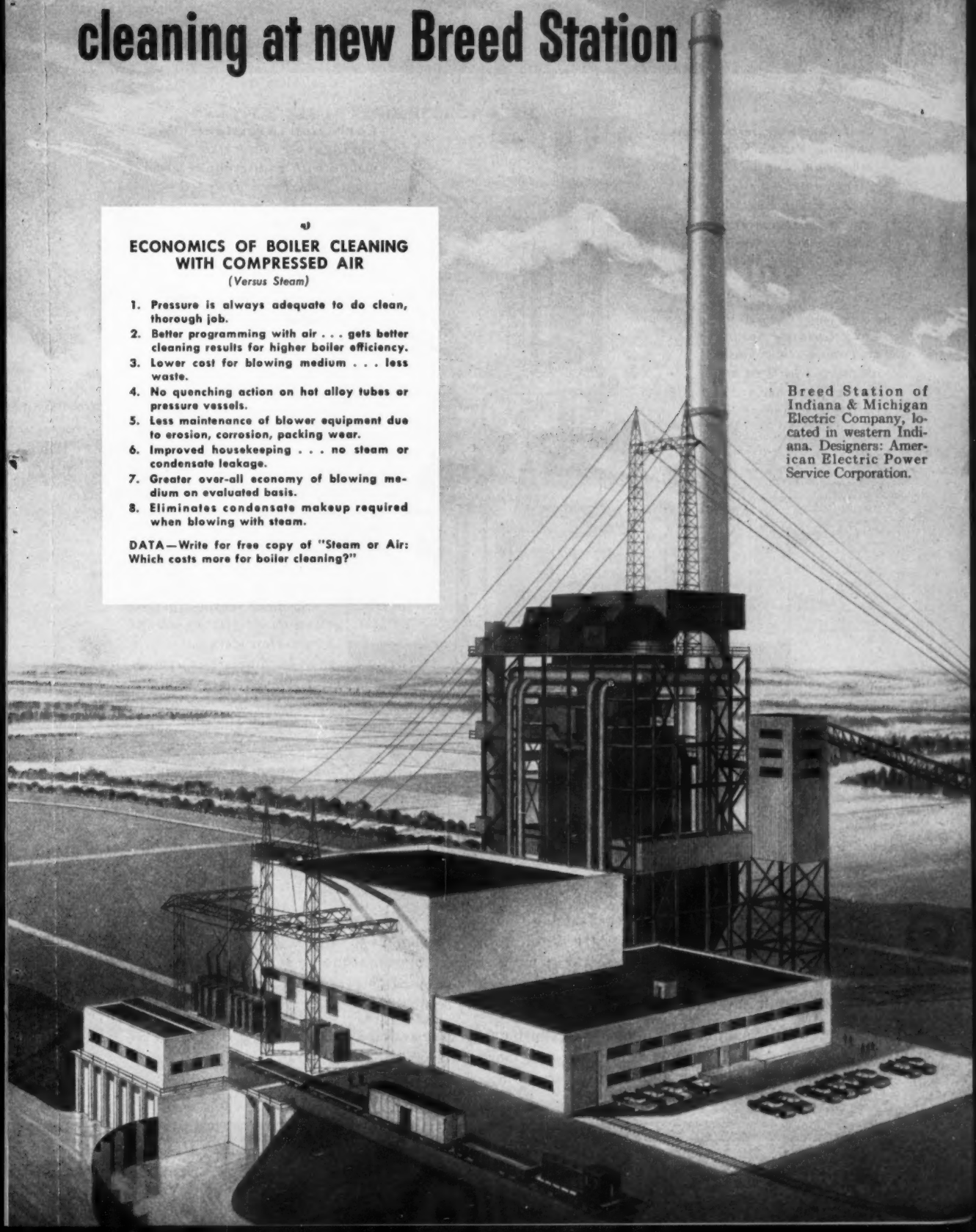
cleaning at new Breed Station

ECONOMICS OF BOILER CLEANING WITH COMPRESSED AIR

(Versus Steam)

1. Pressure is always adequate to do clean, thorough job.
2. Better programming with air . . . gets better cleaning results for higher boiler efficiency.
3. Lower cost for blowing medium . . . less waste.
4. No quenching action on hot alloy tubes or pressure vessels.
5. Less maintenance of blower equipment due to erosion, corrosion, packing wear.
6. Improved housekeeping . . . no steam or condensate leakage.
7. Greater over-all economy of blowing medium on evaluated basis.
8. Eliminates condensate makeup required when blowing with steam.

DATA—Write for free copy of "Steam or Air: Which costs more for boiler cleaning?"



Breed Station of Indiana & Michigan Electric Company, located in western Indiana. Designers: American Electric Power Service Corporation.

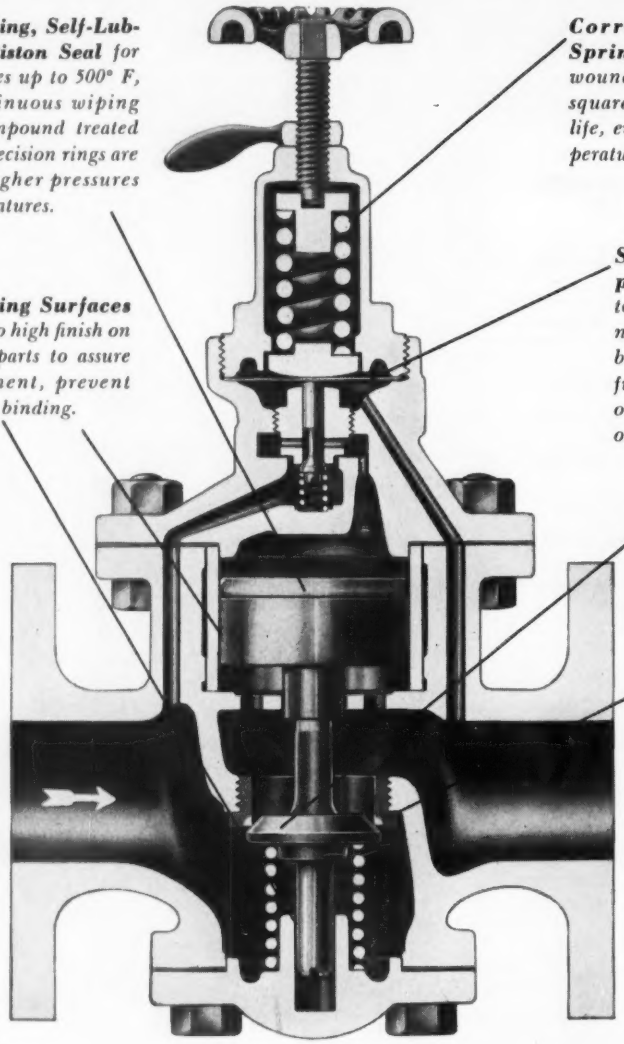
HERE'S WHY YOU GET EXTRA VALUE COMPLETE LINE OF

Self-Cleaning, Self-Lubricating Piston Seal *for temperatures up to 500° F, gives continuous wiping action. Compound treated cast iron precision rings are used for higher pressures and temperatures.*

Corrosion-Resistant Springs *are accurately wound with ends ground square. Maximum spring life, even under high temperature conditions.*

Stainless Steel Diaphragm *responds instantly to any flow change—eliminates stuffing boxes and bellows seals. Diaphragm's full travel is less than its own thickness, can't be over-stressed.*

Long Guiding Surfaces *are ground to high finish on all moving parts to assure true alignment, prevent cocking and binding.*



Single Seated Construction *assures positive dead end shut off.*

Stellited Seating Surface *combined with a hardened stainless main valve provides ultimate in erosion resistance.*

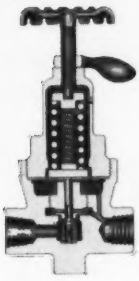
Interchangeable parts *May be replaced without taking valve body off the line, and, even more important, without machining.*

Cutaway of Leslie internal pilot, piston operated reducing valve class LY, shows typical Leslie quality construction features. Throughout the Leslie line, features like these and others presented on the next page are your assurance of lower operating costs and long life performance. They are based on over 50 years of leadership in designing and manufacturing quality regulators.

Internal pilot piston operated reducing valves are available for steam services, up to 2500 lbs., ASA, reduced pressure ranges to 1400 psi. Sizes ½ to 6". Cast iron, bronze, steel or alloy steel construction.

LC-9

IN LESLIE'S REDUCING VALVES AND REGULATORS



LESLIE SMALL FLOW REDUCING VALVES

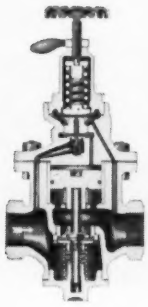
Leslie small flow reducing valves are used in pilot plant operations, plastic molding presses, laboratory units, gland sealing, steam sterilization and atomizer units and wherever control of small flows of steam, air, gas or non-corrosive liquids are a problem.

These ½" valves feature simple, direct operated design with screwed or bolted adjusting spring assembly for easy access to the internal parts. No stuffing boxes or fussy seals.

PRESSURE-TEMPERATURE RANGES

BODY MATERIALS AND CONSTRUCTION	CLASS	MAX. INLET PRESSURE PSI		MAX. TEMP. °F.	MIN. PRESS. DROP PSI	REDUCED PRESS. RANGE PSI
		STEAM	COLD LIQUID AIR OR GAS			
BRONZE Screwed Bonnet	LCA	—	400	150	10	5-285
	LCB LCC LCD	300	400	550	10	10-285
	LCLA	—	400	150	10	2-35
	LCLB LCLC LCLD	300	400	550	10	2-35
STEEL Thru-bolted Bonnet	LCL(B)S LCL(C)S LCL(D)S	600	1000	750	10	25-600 10-50

LESLIE REDUCING VALVES FOR AIR OR GAS SERVICE



Leslie internal pilot, piston operated reducing valves offer a combination of accurate regulation and low maintenance service, and are used for accurate control of air or gas with inlet pressures up to 400 psi at 150° F.

Accuracy of regulation is comparable to instrument control with full flow for equivalent pipe size. Valves feature 99% accuracy of regulation at rated capacity.

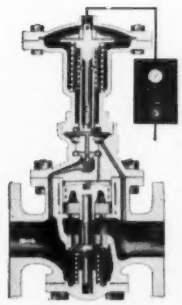
Positive, bubble tight shut-off is provided by resilient, single seated valve disc. Fully guided main valve, stainless steel diaphragm and non-corroding internal springs assure long, trouble-free operation.

PRESSURE RANGES AND CONSTRUCTION

CLASS	SIZE (Inches)	MAXIMUM INLET PRESSURE & TEMP.	REDUCED PRESSURE RANGE-PSI		BODY MAT'L.	END CONNECTIONS
			MIN.	MAX.		
LA-5 LAE-5	¼-4	25-400 psi 150° F max.	5*	285	Bronze	½-2" 300 lb. screwed ½-4", 150 & 300 lb. MSS flanged
LAK LAEK		25-400 psi 150° F			Cast Iron	½-2" 250 lb. screwed 1½-3" 250 lb. ASA flanged
		25-175 psi 150° F max.				1½-4" 125 lb. ASA flanged

*5% of inlet pressure over 100 psi

REMOTELY ADJUSTED REDUCING VALVES



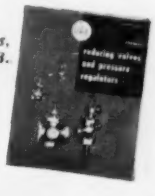
Operating characteristics of Leslie remotely adjusted reducing valves are identical to manually adjusted types. The remotely adjusted reducing valve is adjusted to the desired pressure setting by air pressure from an air loading device. The constant loading force on the upper diaphragm opens the pilot valve and is balanced by a constant reduced pressure proportional to the loading force.

The air loading panel eliminates hazardous or inconvenient adjustments and provides fast means of readjusting pressure to meet changing requirements.

REMOTELY ADJUSTED REGULATING VALVES

TYPE	SIZES AVAILABLE (Inches)	BODY MATERIALS AVAILABLE	INLET PRESSURE RANGES (PSI)	MAXIMUM REDUCED PRESS. (PSI)
Small flow, internal pilot actuated, diaphragm operated	¼, ⅜, ½	Bronze	20-300 psi 550° F steam 20-400 psi 150° F air	175
Internal pilot actuated, piston operated	½ - 6	Cast Iron Bronze Cast Steel	25 psi up to 600 psi, 750° F	175
Internal pilot actuated, piston operated for high pressure service	½ - 3	Cast Steel and Alloy Steels	300 psi up to 3000 psi	700

For sizing and capacity data on this Leslie line of valves, contact your Leslie engineer or write for Bulletin 5302B.



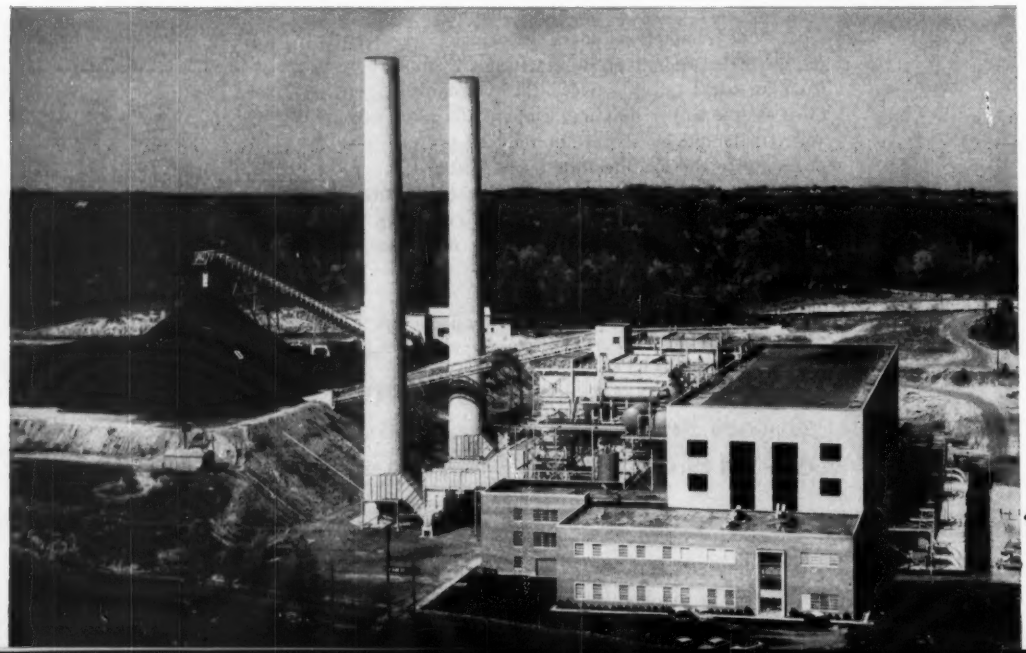
TRADE LESLIE MARK

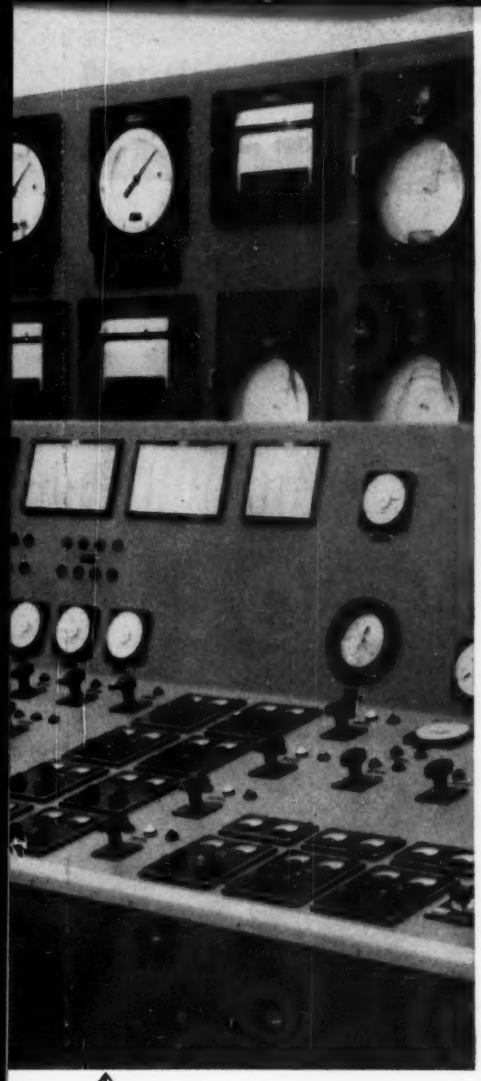
REGULATORS and CONTROLLERS

Leslie Co.; 435-C Grant Avenue, Lyndhurst, New Jersey

Over 275 Factory-Trained Engineers At Your Service—Nationwide!

For more facts circle 214 on Reader Service card, p 97





Republic Electronic System Controls New McMeekin Station

At the new Silas C. McMeekin Station of South Carolina Electric and Gas Company two 910,000 lb/hr boiler systems are operating under all load conditions at maximum efficiency with the help of Republic Flow Meters Co. electronic combustion and feedwater control.

From the central control room—nerve center of the power plant—Republic electronic equipment in two master consoles provides continuous data and control for feed pump, feedwater, combustion, and superheat and reheat temperature. Important measurements of temperature, pressure, and flow are fed into an automatic data logging system and are recorded hourly. This complete control package was engineered by Republic working with Gilbert Associates, Consulting Engineers of Reading, Pa.

The Silas C. McMeekin Station is another example of Republic Flow Meters combustion control system engineering service at work. Republic's engineering experience in plants of all sizes, all pressure and temperature ratings and all load characteristics is your best guarantee of premium equipment performance. A technically-trained, thoroughly experienced Republic Sales Engineer is ready to discuss your instrument and control problems. Contact your nearest Republic representative, or write Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto. Subsidiary of Rockwell Manufacturing Company.

CENTRAL CONTROL ROOM

Located in control consoles are the vital Republic electronic combustion, feedwater, and temperature controls that monitor and regulate boiler system.

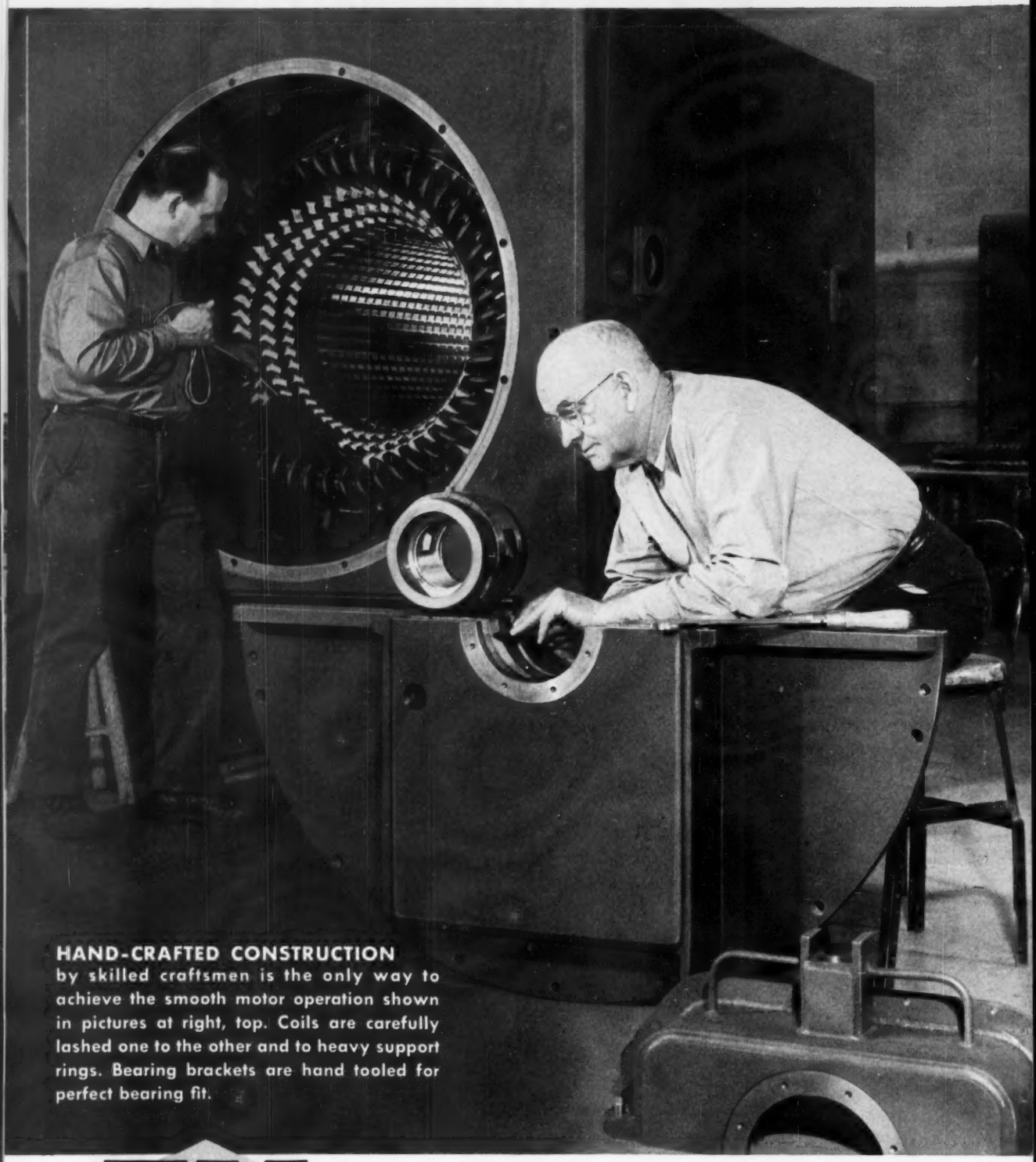
SILAS C. MCMEEKIN STATION

When operating at capacity, this new station can provide 2,409,000,000 kwh annually for the customers of South Carolina Electric and Gas Company.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

A look inside an E-M Straight-Up-Ventilated

A Smooth Running Motor



HAND-CRAFTED CONSTRUCTION
by skilled craftsmen is the only way to achieve the smooth motor operation shown in pictures at right, top. Coils are carefully lashed one to the other and to heavy support rings. Bearing brackets are hand tooled for perfect bearing fit.

E-M

ELECTRIC MACHINERY

Builders of the new pump motor

1300-TPA-2203

Boiler Feed Pump Motor will show you

Doesn't Just Happen...

LISTEN CLOSELY. This running E-M Motor is not dead silent—just remarkably quiet. And when you stand near an E-M Straight-Up-Ventilated Motor, you aren't blasted in the face with hot air. Cooling air goes straight up.

NICKEL-ON-EDGE demonstrates fine balance of operating E-M boiler feed pump motor. Engineers visiting E-M factory learn Straight-Up-Ventilated Motor balance is far superior to usual commercial standards.

Quiet operation, precise balance result from E-M's imaginative engineering, thorough workmanship

The eye-opening boiler feed pump motor performance pictured above isn't confined to the test floor. It lasts for years. And E-M planned it this way because power plant engineers asked for it.

Yes, here is a motor that embodies those design features most wanted by power plant engineers:

1. Locked-in rotational stability that assures a lifetime of smooth operation.

2. Built-in acoustical control that makes the motor as quiet as the pump.

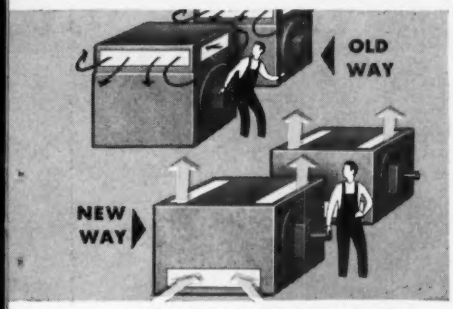
3. Top air discharge that carries ventilating air up and away—no recirculation or cross circulation to affect cooling of motors.

4. Easy access that enables one man to disassemble the motor for routine inspection without a hoist.

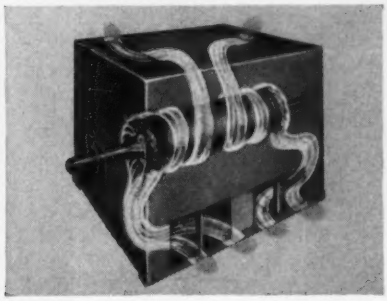
5. A low silhouette that lets you look over the motor to see other personnel and equipment in the pump room.

Your nearby E-M Field Engineer will be glad to give you complete details of E-M's finer motor construction. Call him, and write the factory for your free copy of the Straight-Up-Ventilated Motor Brochure No. 1134P.

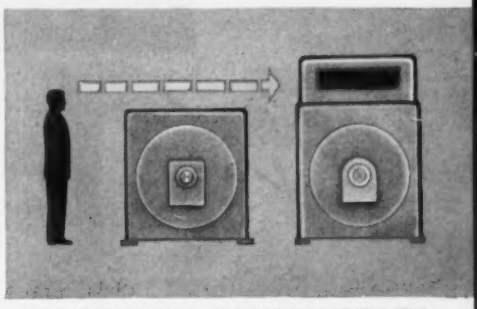
MANY BIG DIFFERENCES MAKE THE DIFFERENCE



STRAIGHT-UP-VENTILATION



AIR-FLOW ACOUSTICAL CONTROL



MINIMUM HEIGHT—MAXIMUM VISIBILITY

MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

that performs as well on the job as on the test stand

For more facts circle 216 on Reader Service card, p 97

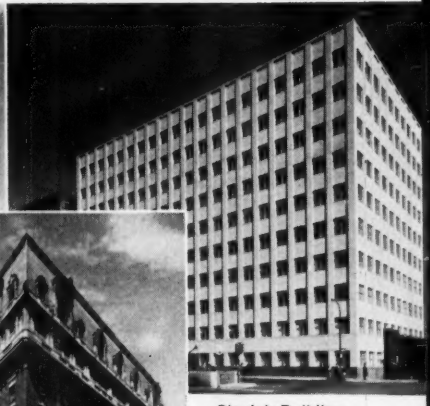
Kemper Building

Inland Steel Building

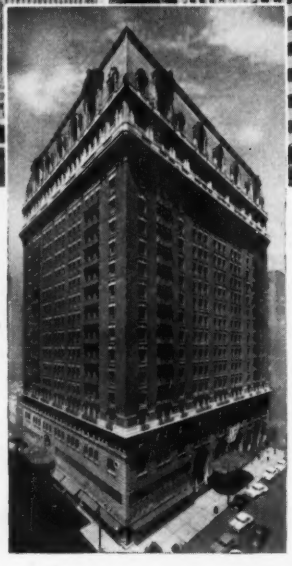
Addition to Harris Trust and Savings Bank

Chicago's finest depend on

Merchandise Mart



Sinclair Building



LaSalle Hotel

Borg-Warner Building

Field Building

Wrigley Building

Johnson air-conditioning control

It would be difficult to name a group of buildings *anywhere* with quality standards more obvious or better known than those of these familiar Chicago buildings.

Here, as in countless leading buildings where quality is the key consideration, you'll find Johnson Air-Conditioning Control Systems. When you build or modernize, keep in mind, too, that the quality features of a Johnson System result not only in outstanding performance but also in unmatched operating economies. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Branch Offices.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

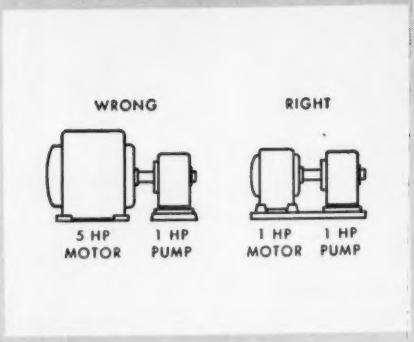
DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

Tribune Tower

Tips on evaluating Electrical

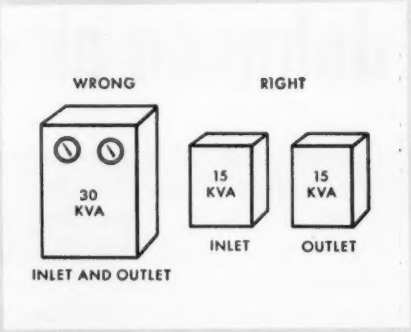
Matched Electrical Sets

You wouldn't use a 5 h.p. motor to run a pump that required only one h.p. Similarly, electrical sets should be *matched* to the requirements of the specific job. Electrical sets should be sized according to gas conditions, dust conditions, and other operating characteristics, and in accord with manufacturers' past experience on similar installations. *Don't be misled by high KVA ratings on the electrical sets.* The precipitator will only absorb a certain amount of power and the sets should be sized accordingly. A large excess of installed power, which will never be used, means inefficient use of the equipment.



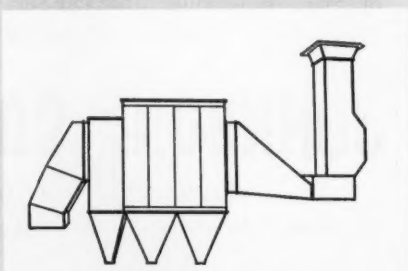
Varied Electrical Conditions

Electrical conditions in a precipitator can vary widely at different parts of the precipitator. For instance, a high voltage, low current condition usually prevails at the inlet where the dust load is high, as compared to a lower voltage higher current condition at the outlet. Consequently, it is good design (and a necessity for high efficiency) to furnish several electrical sections in series, with energization from separate electrical sets so that each section can be adjusted to best suit the conditions.



Gas Distribution

Remember that gas distribution, gas baffling, and provision against hopper sweeping all have a large influence on collection efficiency. The gas flow system should be analyzed as closely as possible, both in the precipitator and in the associated ductwork. If in doubt, have a three-dimensional gas flow study made. Two-dimensional gas flow studies *are not as accurate* and may lead to erroneous conclusions.



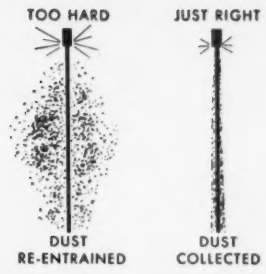
RESEARCH

RESEARCH-COTTRELL, INC. Main Office and Plant: Bound Brook, New Jersey

GC 191

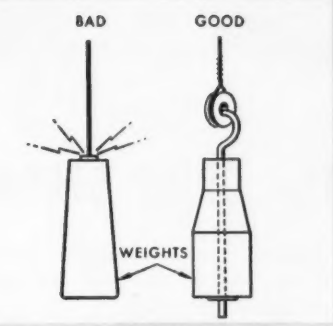
Precipitators

Some helpful hints to aid in selecting a properly designed unit



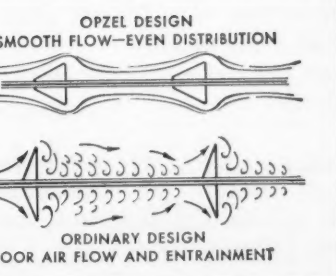
Rapping Intensity

Rappers should have easy means to vary the intensity of the blow to suit variations in operating conditions. A pre-set intensity setting cannot possibly give proper rapping over the normal range of operation. If too soft, build-up will occur which will disturb electrical conditions. If *too* hard, there will be reentrainment. Means of intensity adjustment are necessary to avoid drop-off of precipitator efficiency as conditions change.



Corona Discharge

It is a relatively easy matter to obtain a corona discharge in an electrostatic precipitator. Many types of discharge electrodes have been used over the past forty years, including ribbons, squares, twisted squares, star shaped sections, coiled wires, wires with prongs and projections, most of which give entirely adequate corona conditions. Final choice then gets down to mechanical factors such as strength of wire, method of support to avoid stress points, and ease of handling. There are many claims made for various types of wires but after investigating and testing hundreds of different kinds, we find a straight round wire about .1" diameter to be best.

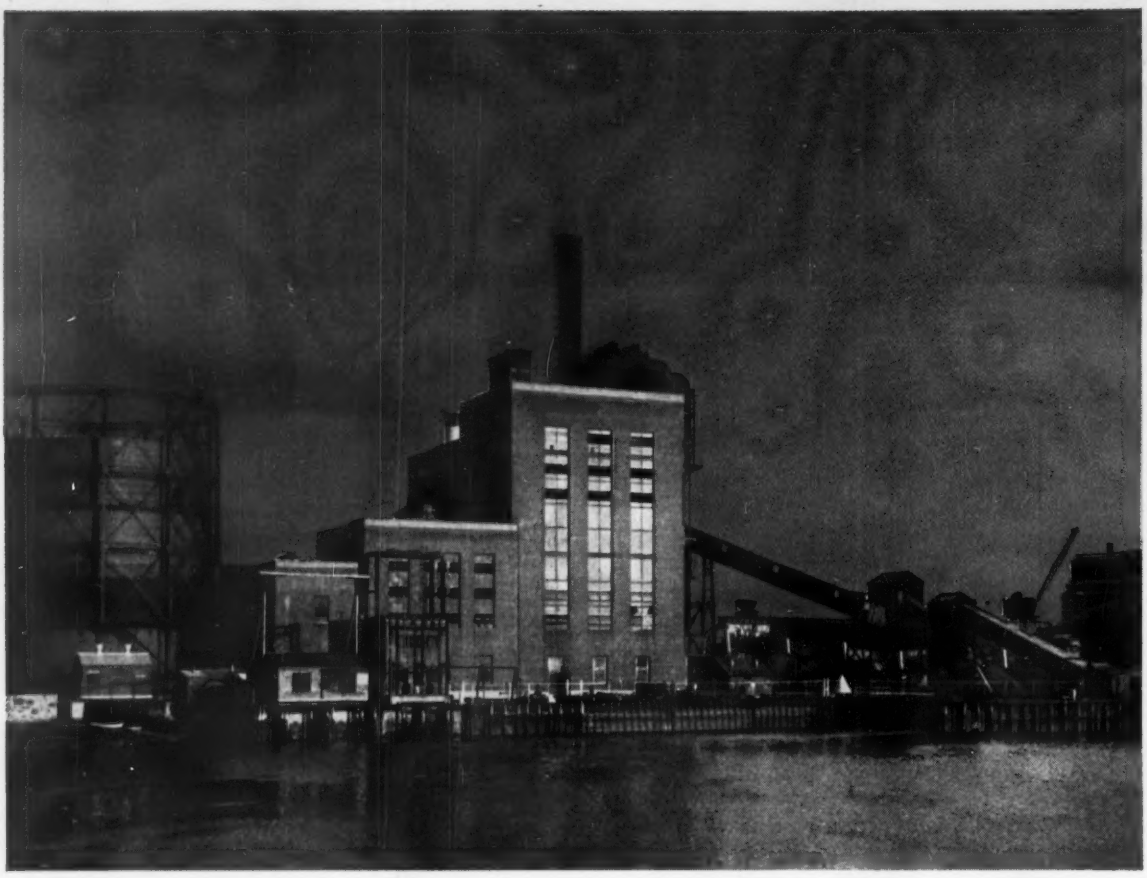


Baffle Design

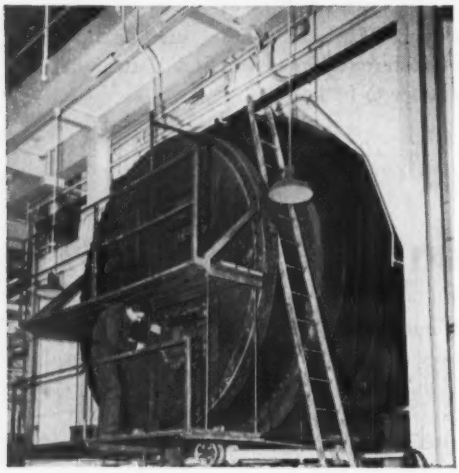
Careful attention to the design of baffles on the collecting plates is most important. Small amounts of reentrainment mean tremendous differences in over-all collection efficiencies. It is seen that the "quality" of the collecting surface is far more important than quantity — quantity (sq. ft. of surface or treatment time) in itself is not a criterion of performance.

-COTTRELL

Representatives in all major cities of U.S. and Canada



After 17 years...
99% OF ORIGINAL BRIDGEPORT TUBES STILL GOING STRONG



Condenser for main turbogenerator in which Bridgeport tubes maintain a record of high efficiency and long life.

This steam condenser tube record at a New England utility isn't often equaled. The 25,000 sq. ft. condenser in this plant contains 4,340 18-gauge Bridgeport Aluminum Brass tubes, each 22 ft. by 2$\frac{7}{32}$ in. In 17 years of operation only five tubes have had to be replaced.

The plant serves 100,000 people, generating a total of 65,000 kw. The condenser uses harbor salt water, filtered through half-inch mesh screening with chlorine added for slime control. The harbor water has a high ammonia content.

Tubes are Aluminum Brass—77% copper, 2% aluminum and 21% zinc—a *standard* Bridgeport alloy that, in this case, is giving *exceptional* service.

Making the exception the rule is an everyday occurrence at Bridgeport. Technical Service, research, and manufacturing techniques and facilities—all are aimed at duplicating stories like this in condenser and heat exchanger operation.

A call to your nearest Bridgeport Sales Office puts this assistance at your elbow. (Dept. 5408)

Bridgeport Brass Co.

BRIDGEPORT CONDENSER TUBES

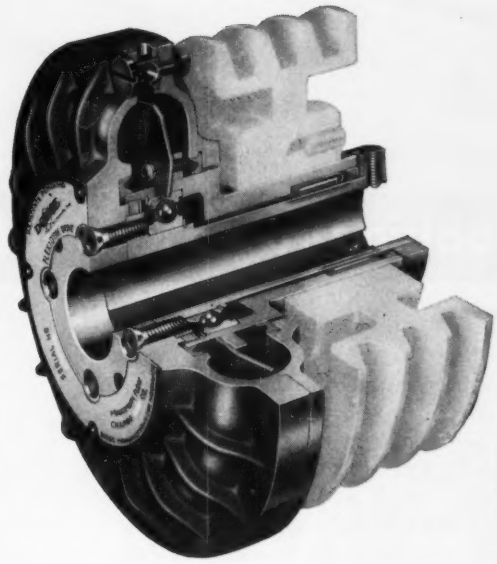
Bridgeport Brass Company, Bridgeport 2, Conn. • Sales Offices in Principal Cities

In Canada: Noranda Copper and Brass Limited, Montreal

For more facts circle 219 on Reader Service card, p 97

WHAT'S YOUR PROBLEM?...

- ☑ Overheated motors?
- ☑ Excessive belt maintenance?
- ☑ Breakage of materials being processed —like thread, wire, paper?
- ☑ Expense of oversize or high torque motors?
- ☑ High demand rate?
- ☑ Expense of reduced voltage starters?
- ☑ Clutch trouble?
- ☑ Breakage of transmission parts due to instantaneous shock loads?
- ☑ Damage and recurring down-time from overloads?



FLEXIDYNE

THE DRY FLUID DRIVE

It is no longer necessary to accept the destructiveness—the costliness—of conventional starting in the mechanical transmission of power. Flexidyne changes that!

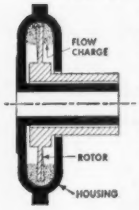
Flexidyne is the new way to start loads *smoothly*—to protect against shock and overload—to save power—all *without any sacrifice of efficiency at full load!*

This revolutionary development is ushering in "the day of the soft start"—which can mean thousands of dollars to you in equipment savings and in better, more economical operation.

Flexidyne is available, off the shelf, in Drives and Couplings. Capacities range from fractional to 1,000 hp. Ask your local Dodge Distributor or write us for technical bulletin.

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

HOW FLEXIDYNE WORKS



The "dry fluid" in Flexidyne is tiny heat-treated steel shot. A measured amount, called the "flow charge," is contained in the housing, which is keyed to the motor shaft. Inside the housing is a rotor, free to revolve relative to the housing, but connected to the load.

When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, packing it between the housing and the rotor, which transmits power to the load. Initial slippage is momentary. Housing and rotor become locked together and achieve full load speed without slip and at 100% efficiency.

CALL THE TRANSMISSIONEER — your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE

of Mishawaka, Ind.

For more facts circle 220 on Reader Service card, p 97

from the . . .
"HORSE and BUGGY" DAYS

• Shown at left is one of the first portable boilers. This was a horse drawn combination boiler and steam engine built in sizes from 6 to 20 horsepower and popular during the 1860's.

from the Dobbin Drawn Portable .

• As you can see, Erie City Iron Works has been in the boiler business a long, long time. Before the turn of the century we were building portable boilers similar to the horse drawn unit above. Simple in operation and rugged in construction, this type boiler gave many years of dependable service particularly in oil field and sawmill work.

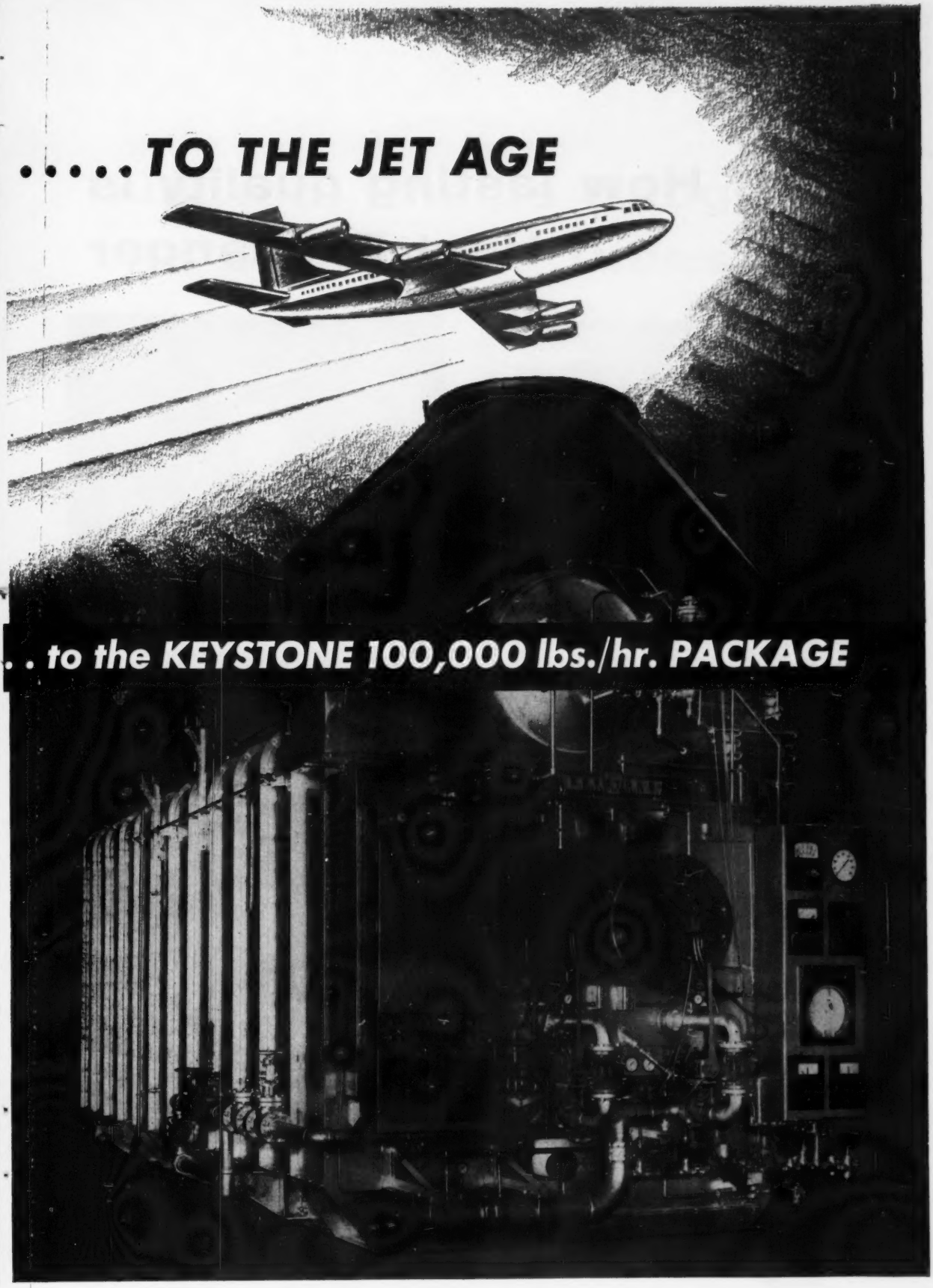
Today we build a complete line of firetube and watertube package steam generators from 1,700 lbs./hr. to the present 100,000 lbs./hr. unit shown at the right. This Keystone is a complete, modern package with burners and controls piped and wired prior to shipment. The natural circulation boiler is symmetrical in design with steel encased insulated side walls. No baffles, handholes or key caps are required on this unit. Maximum heating surface coupled with conservative ratings produce low exit temperatures and highest efficiencies.

Investigate the possibilities of renovating an antiquated, costly power plant with Erie City Keystone Steam Generators — modern as a Jet, rugged in construction and simple to operate. Write for bulletin SB-5991-H.

You can depend on ERIE CITY *Since 1840* *for sound engineering*

ERIE CITY IRON WORKS · Erie, Pa.

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
WASTE HEAT BOILERS • FIRE and WATER TUBE PACKAGE BOILERS
OIL and GAS BURNERS • STOKERS • PULVERIZERS



For more facts circle 221 on Reader Service card, p 97

How lasting quality is Heat Exchanger

Fabrication of Phelps Dodge heat exchanger and condenser tubes starts with the casting of billets. In this process, high grade copper (over 99.90% pure) from Phelps Dodge's own mines is alloyed with the finest quality metals available. The alloys are melted in electric furnaces and cast in specially designed water-cooled molds that produce sound, homogeneous billets.

Each billet must conform to rigid Phelps Dodge standards, as well as to the requirements of ASTM and U.S. Government specifications. Strict control is maintained over every phase of the billet-casting operation.

Before melting, the metals to be alloyed are carefully weighed to their correct proportions in the cast billet. Each melt is carefully sampled for chemical and spectrographic analyses which verify the composition of the billet before it is released for further processing.

Throughout the entire tube fabrication—from raw materials to finished product—quality is the keynote. That's why Phelps Dodge tubes are preferred by those who demand the finest . . . the manufacturers and users of heat exchangers and condensers.

1 BILLET-CASTING

(FIRST OF A FIVE-PART SERIES)

Casting shop area in new Phelps Dodge tube mill at South Brunswick, N. J. This mill has the largest copper and copper-alloy tube capacity in the U. S.

Alloy proportions are carefully checked by spectrographic analysis to assure conformance with exact specifications.

built into Phelps Dodge and Condenser Tubes...

Close-up of casting operation shows molten metal flowing from electric furnace into specially designed molds.

PHELPS DODGE COPPER PRODUCTS CORPORATION

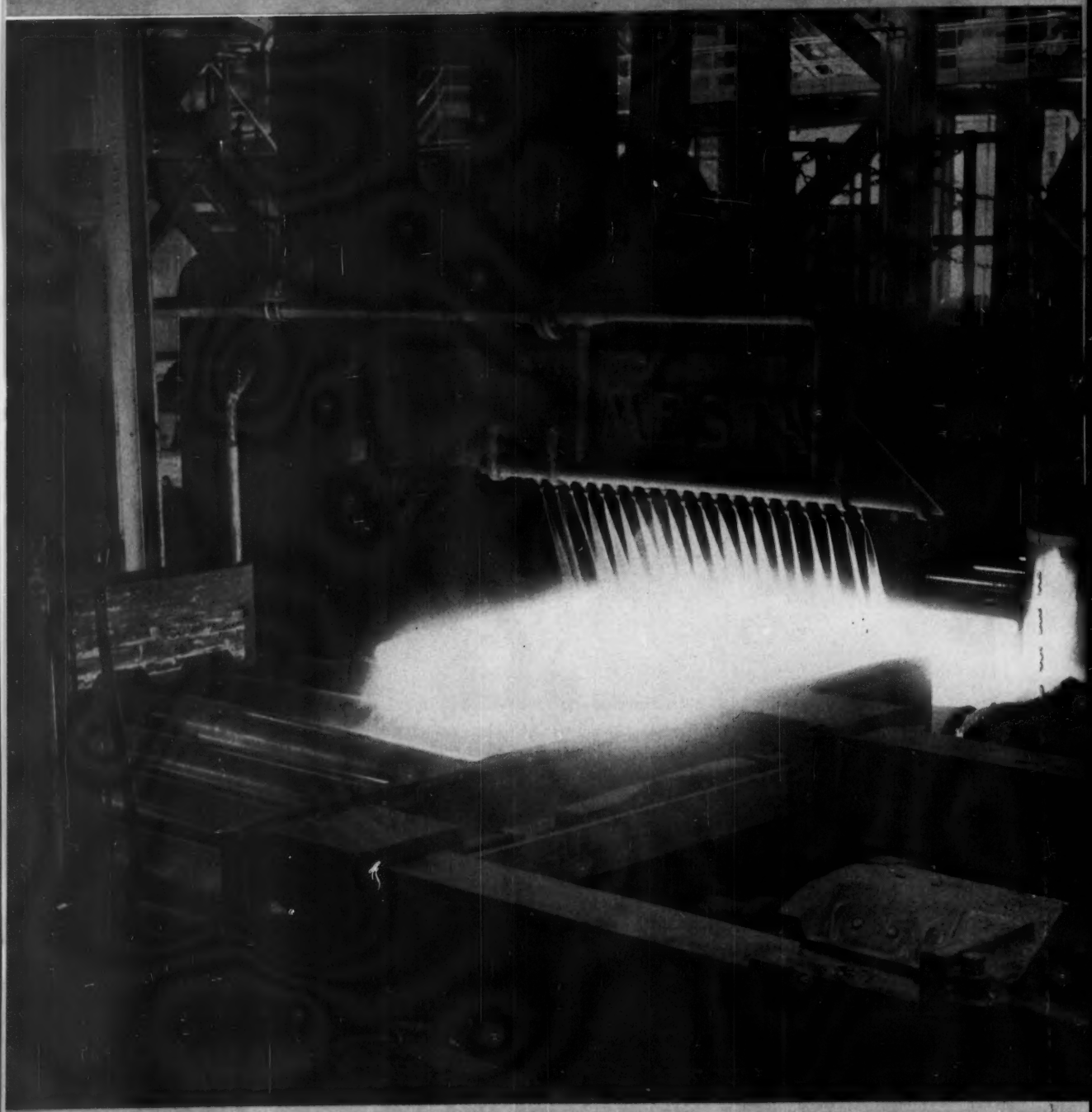
First for Lasting Quality—from Mine to Market!

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

For more facts circle 222 on Reader Service card, p 97

DE LAVAL
CENTRIFUGAL PUMPS

for high-pressure

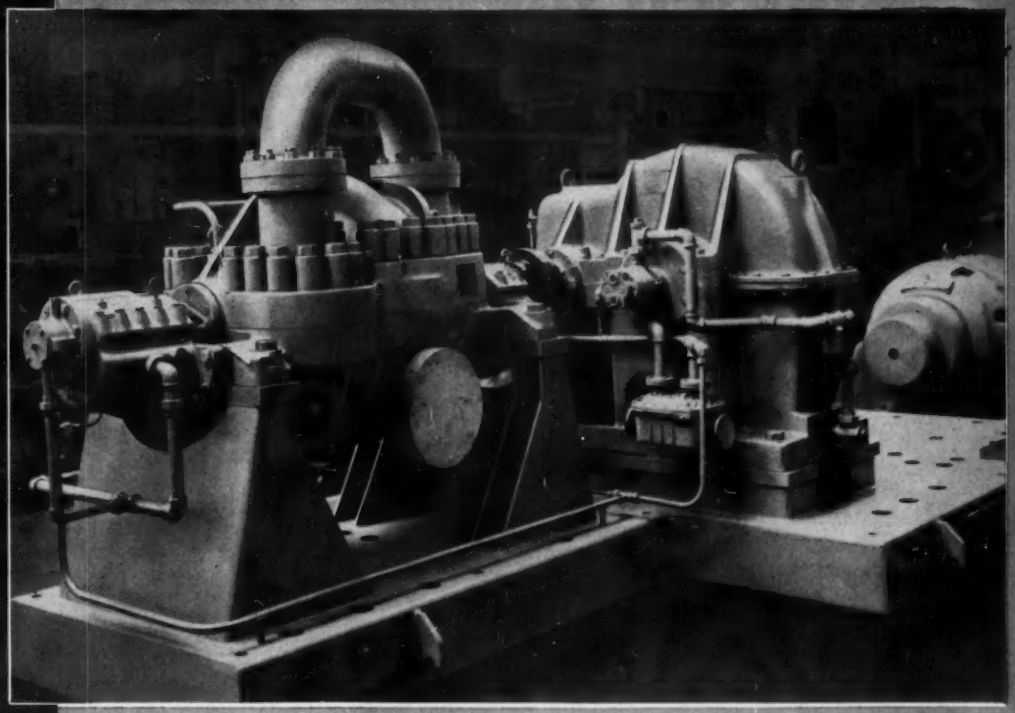


descaling at Lukens Steel

Latest successful technique of high-pressure descaling is now being performed in this modern steelmaking facility designed by Mesta Machine Co.

The initial high-pressure descaling operation uses De Laval split-case multi-stage pumps as shown in the photograph below. Each pump supplies cold water at 1000 gpm and 1600 psig. Electric motors rated at 1750 hp drive the pumps through speed increasers which raise the speed from 1200 rpm to 4250 rpm.

De Laval pumps also serve Lukens on a 1200 psig descaling system in another section of the Coatesville, Pa. mill.

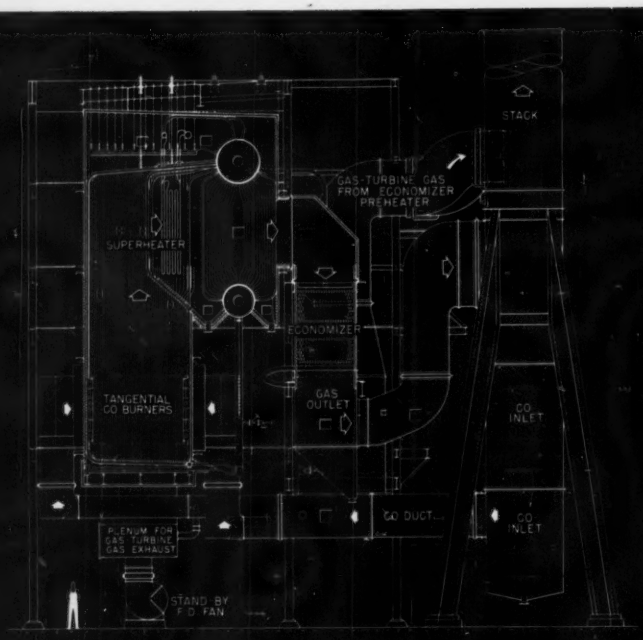


One of several arrangements available for descaling service at pressures of 1000-1200-1600 psig and capacities to 2200 gpm.

DE LAVAL *Steam Turbine Company*

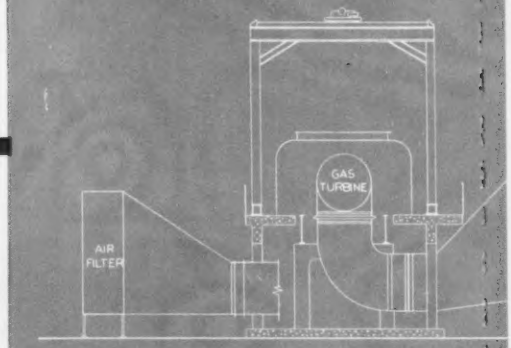
815 NOTTINGHAM WAY, TRENTON 2, NEW JERSEY

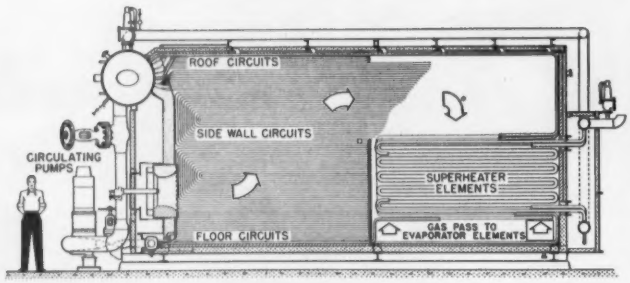
Special boilers for special



For refineries

C-E Vertical Unit Boiler, Type VU-40 CO – tangentially fired boilers to efficiently utilize energy potential in hard-to-burn waste catalyst regenerator gas. Illustrated is an installation at a Gulf Coast refinery. It combines a catalyst regenerator, two gas turbine-driven compressors, two CO boilers, and separate turbine-exhaust-gas feedwater heaters located between the boilers. Available in a wide range of sizes for any quantity of catalyst regenerator gas and for any steam capacity, CO Boilers by C-E have been in service more than three years.





For diverse industrials

C-E Package Boiler, Type PCC—new, completely shop-assembled, high performance, Controlled Circulation steam generator. Now in service with capacities to 120,000 lb/hr, it is available with temperatures to 900 F. and pressures to 1,000 psi (or higher if desired). This boiler is especially suitable where maximum capacity, temperature, and pressure are required, yet space is limited. Offers easy handling of rapid load swings and high quality steam production. PCC's in service include the world's highest capacity, highest pressure, and highest temperature package boilers.

C-E builds boilers of virtually all designs and types known in present practice . . . in capacities from less than 10,000 to 4,000,000 or more lb. of steam per hr. It is presently building units that will set new world records for capacity, pressure and temperature.

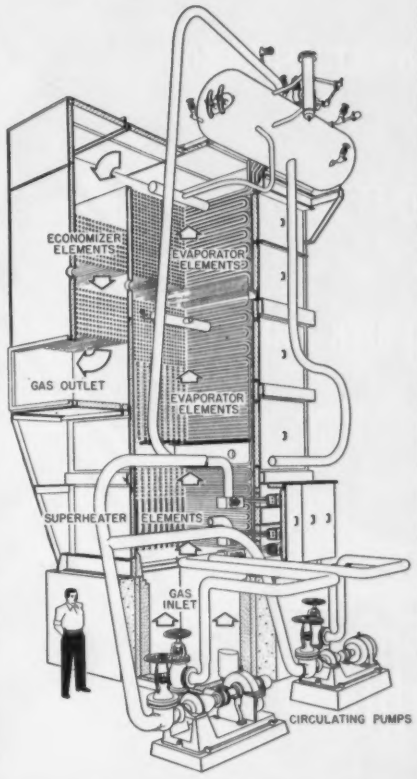
This vast experience has also been successfully applied to the development of many special designs to utilize waste fuels or to meet unusual steam requirements or space conditions.

A few recent examples of special C-E designs which have successfully met unusual problems are illustrated here. In several cases, this success may be attributed to the utilization of exclusive C-E developments such as controlled circulation or tangential firing.

Whether your requirements call for boilers of unusual characteristics, such as those shown here, or for more conventional standard designs, come to C-E where you'll find the skill, experience, facilities—and desire—to meet your needs *exactly*.

For the steel and chemical industries

C-E Package Boiler, Type WCC—a Controlled Circulation design which utilizes waste heat from open hearths or chemical processes. The platen surfaces featured in the first pass permit passage of abrasive or "sticky" gas without erosion or bridging, prolonging boiler life and making the unit easier to clean. Controlled Circulation assures positive control of water to all circuits, permitting a smaller boiler with obvious space-saving advantages. Seven WCC's are now in service; eight others are being erected.



needs – by C-E

For gas turbine installations

C-E Gas Turbine Boiler—waste heat design for economical utilization of gas turbine exhaust sensible heat. Usable in a choice of cycles to obtain fired or unfired heat recovery and steam generation. Illustrated is a combined cycle, two of which are in service at a chemical plant. Here the turbine is followed by a waste heat boiler, multiple-purpose economizers (process and feedwater), and a conventional oil-fired steam generator which uses a portion of the high temperature exhaust gas for combustion air.

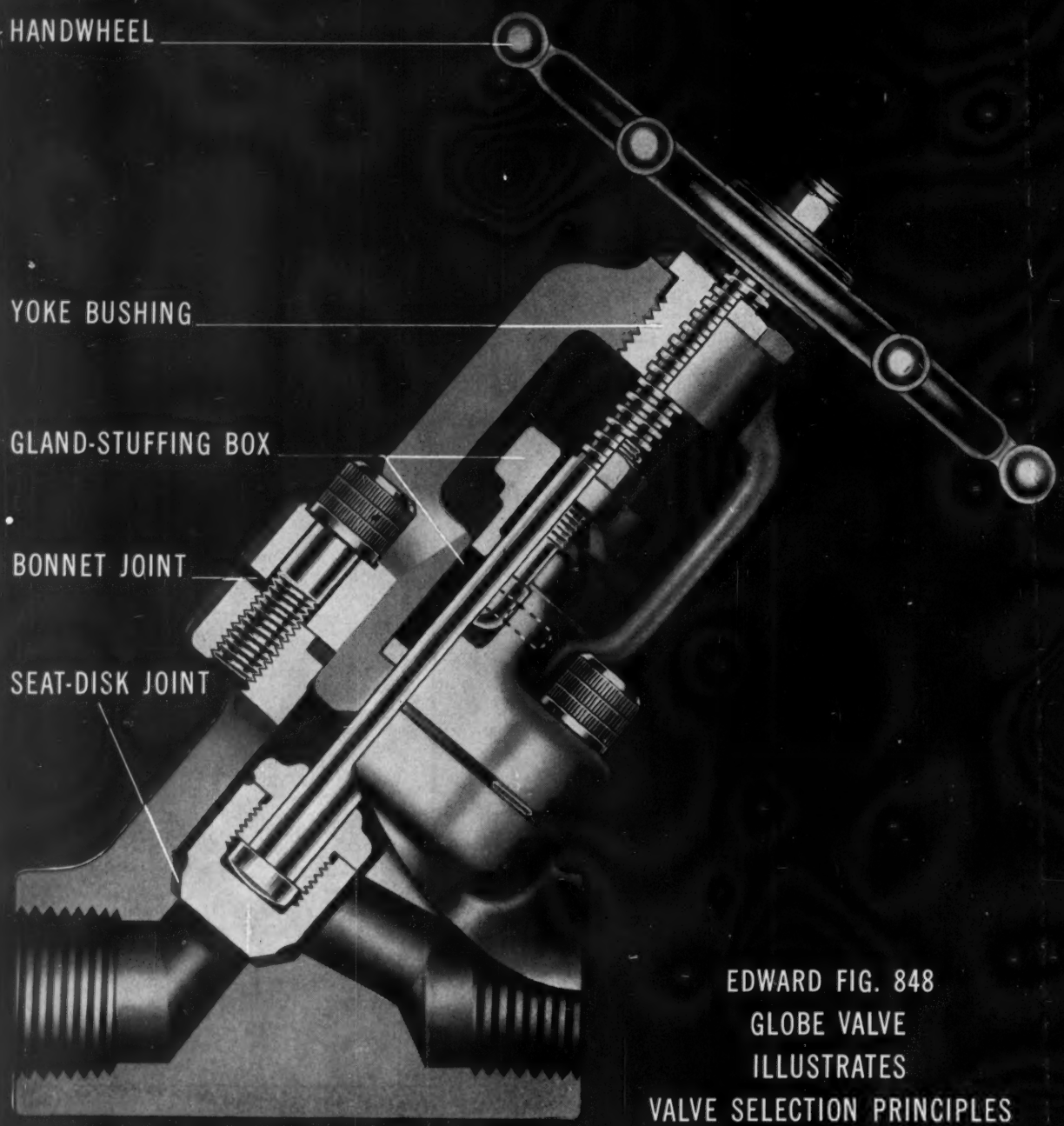
COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

C-195

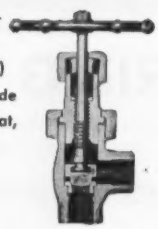
ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 224 on Reader Service card, p 97



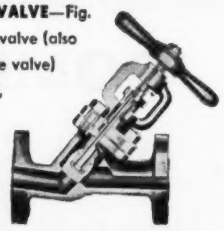
EDWARD FIG. 848 GLOBE VALVE ILLUSTRATES VALVE SELECTION PRINCIPLES

1 ANGLE VALVE—Fig. 2699, 600 lb at 900F (2000 lb WOG) with union bonnet, inside screw, replaceable seat, knobbed handwheel, and screwed ends. Sizes ¼" to 1".



2 UNIVALVE®—Fig. 2224, 1500 lb. at 1050 F (3600 lb WOG) or 2500 lb at 1050 F (6000 lb WOG) with outside screw, Impactor® handle seal-welded bonnet, integral seat and socket welding ends. Sizes to 2½".

3 BLOW-OFF VALVE—Fig. 641, straightway valve (also available as angle valve) 300 lb at 850 F, 600 lb at 850 F, 1500 lb at 850 F, with integral Stellite seat, flanged ends, bolted bonnet. Sizes to 2½".



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT FORGED STEEL VALVES

When you need forged steel globe or angle valves (2½" and smaller) for high-pressure and/or high-temperature applications, you can save money on your installations as well as reduce future maintenance expense by making sure you select the proper valve. Here are a few suggestions.

VALVE CONSTRUCTION DETAILS
(See large illustration, opposite page)

Valve Handwheel or Handle should be large enough to operate valve easily. Wheel spokes help keep handwheel cool. Knobbed design permits tight grip even with greasy gloves. Impact type handle will be helpful in obtaining tight closure for valves 1½ to 2½ in.

Yoke Bushing material should be checked. High-strength aluminum bronzes are usually best. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Gland-Stuffing Box—Stuffing box with bolted gland assures good packing compression; hinged bolts swing out of the way but don't get lost. Be sure to get stainless steel bolts for maximum resistance to rusting, and for easy adjustment even after years of service. Packing chamber should be deep and not excessively wide.

Bonnet Joint of bolted construction is easiest to work with. You can disassemble and reassemble with pocket-size tools. Union bonnet is compact and usually less expensive for smaller valve sizes, but is not recommended for high temperatures. Bonnet gasket of soft iron performs well in most services but spiral wound metallic-asbestos gaskets are superior in high temperature services. For extreme pressure-temperature services welded bonnet joints for permanent tightness are desirable. Seal-welded type bonnet has advantage over fully welded design because it permits disassembly and reassembly.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750 F.

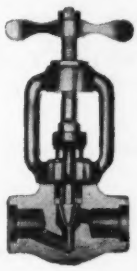
Other Features to Evaluate—Valve compactness is important because you frequently find small piping located in crowded quarters. Inclined bonnet globe valves are less likely to erode due to high velocities—have less pressure loss. Valves of "inside screw" design (stem threads below packing chamber) are usually lower priced and give good service where temperature is not too high and where line fluids are free of sediment. But, best design and materials are useless without experienced workmanship and rigid quality control.

VALVE APPLICATION SUGGESTIONS
First, determine whether a standard valve will do the job before ordering expensive special designs. (Your Edward Representative can help you decide.) Often a slight modification of a standard valve, or a combination of standard valves, will do the job. Here are some facts about types of standard valves and their application:

- For many services, angle valves (illustrated by valve #1) reduce installation cost, minimize pressure drop, improve operational convenience. All Edward forged steel stop and stop-check valves from ¼" to 2½" sizes are available in the angle version.
- For high temperature, Edward forged steel valves with seal-welded bonnets (#2) permanently maintain pressure tightness without periodic tightening of bonnet joints.
- For blow-off service, or wherever double valving is required, select sets of valves of the same basic type with hard-faced seating surface for dependability, longer life and interchangeability of parts (#3).
- For permanent tightness, select an instrument valve (#4) with corrosion-erosion resistant hard-faced seat or a valve with stainless steel body. Bonnetless design requires less maintenance.
- Piston-type check valve (#5), available with union, bolted, or seal-welded cover, is best for most services because it will seat tighter, has easily repairable seat face.
- Modern globe and angle stop valves (shown here) are more dependable than gate valves where repeated drop-tight closures are required, may be used for approximate flow regulation and moderate throttling.

YOUR EDWARD REPRESENTATIVE will be glad to give you the complete story on these features, plus the many other advantages of Edward valves—such as positive, pressure-tight backseats, self-centering disks, special stem and packing materials, and many others. Edward builds a complete line of cast and forged steel valves for pressures to 10,000 lbs. For additional information write to Edward Valves, Inc., 1230 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W., Montreal 1, Quebec.

4 INSTRUMENT VALVE—Fig. 952Y, 600 lb or 2500 lb at 850 F (6000 lb WOG) with swing bolted gland, socket welding ends, no bonnet joint. Sizes ¼" to 1".



5 CHECK VALVE—Fig. 5538, piston type, 1500 lb at 1050 F (3600 lb WOG) bolted bonnet, screwed ends, integral Stellite seat. Sizes ¼" to 2".

*T.M. Reg. U. S. Pat. Off.

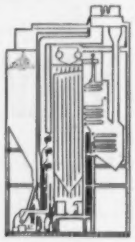
EDWARD STEEL VALVES
another fine product by
ROCKWELL

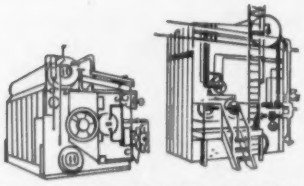
Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

Power Plant Products

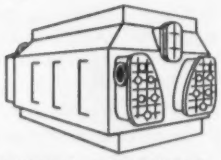
HEAT ENGINEERED BY FW

LARGE STEAM GENERATORS
Designed to meet all requirements for Central Station or Industrial power plants, in single- or twin-furnace designs, with or without reheat or dual circulation.



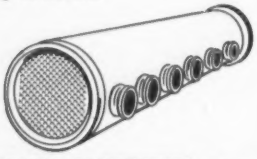


PACKAGED and FIELD-ERECTED BOILERS—Compact, economical, standardized units in capacities from 10,000 to 450,000 lb/hr, oil, gas or pulverized coal fired.

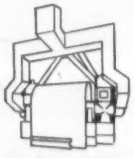


CONDENSERS and HEATERS—Condensers of single or two-pass, double or counter-flow designs. All-welded high and low pressure feed-water heaters.

COOLING TOWERS—Induced draft counter flow towers of all-redwood construction for maximum dependability and long service life.



NUCLEAR COMPONENTS—Heat exchangers, steam generators, pressurizers, reactor vessels, separately-fired superheaters for stationary and marine power plants.



PULVERIZED FUEL SYSTEMS—Completely engineered systems utilizing FW ball mill or MB planetary roll and table pulverizers.

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WORLD'S FIRST

NATURAL CIRCULATION

321,500 kw Unit No. 3 at Detroit Edison's River Rouge Power Plant is served by a Foster Wheeler Reheat Steam Generator —one of the most efficient ever built

One of the largest steam generators ever built, this unit was heat engineered by Foster Wheeler to meet the most exacting plant requirements. It supplies Detroit Edison's River Rouge Unit #3 with *two million* pounds of steam per hour at 2450 psi and 1050 F at the superheater outlet. The steam is reheated to 1000 F after it has passed through the initial stages of the turbine.

Size alone is not the only measure of this installation. The FW steam generator also helps make Unit #3, with a heat rate of 8685 Btu per kwhr, one of the most economical and efficient ever built, producing a kilowatt hour of electricity from less than ¾ lb of coal.

With more than a half century of specialized experience in heat engineering and steam generation, Foster Wheeler will welcome the opportunity to quote on your steam plant units—for any pressure or any capacity. Foster Wheeler Corporation, 666 Fifth Ave., New York 19, N.Y.

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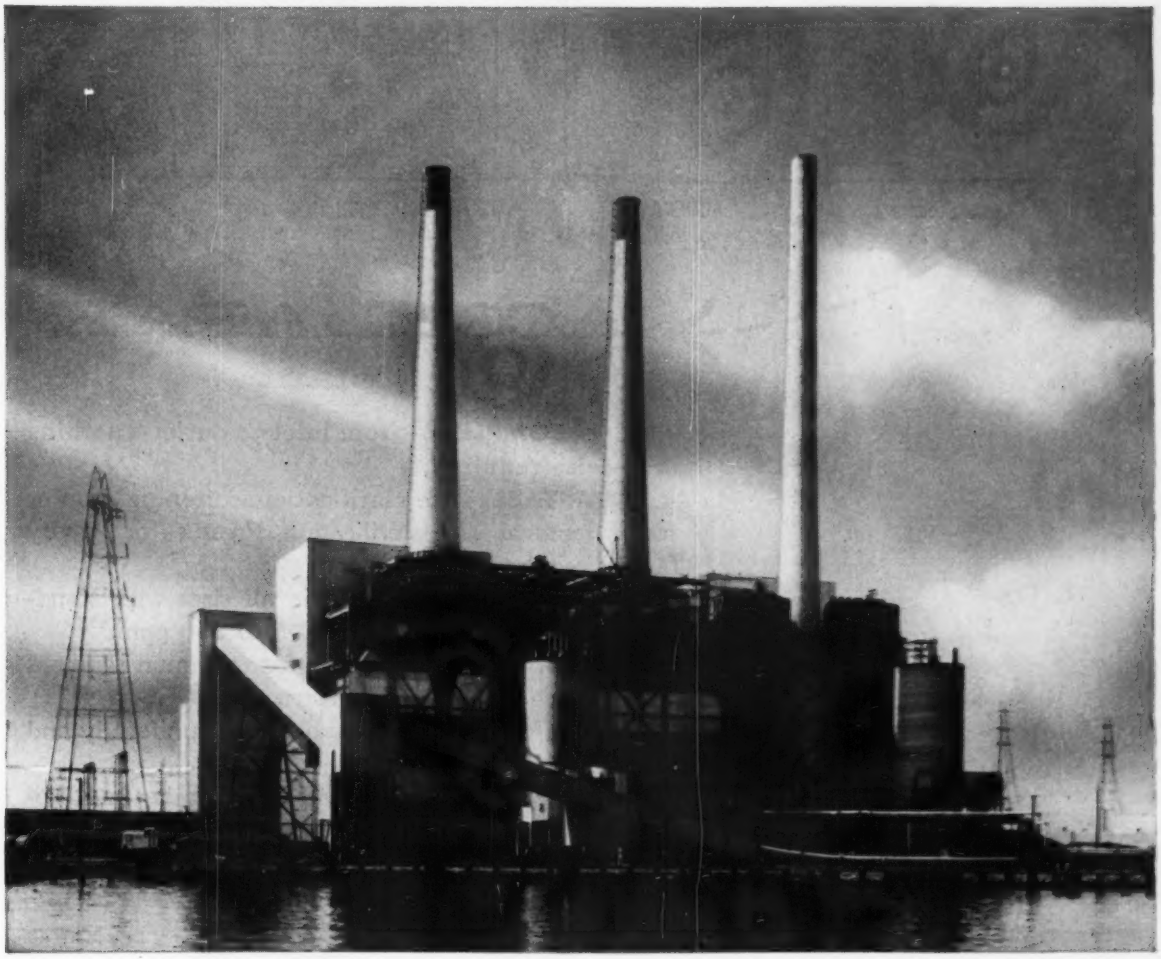
2,000,000 lb/hr

STEAM GENERATOR



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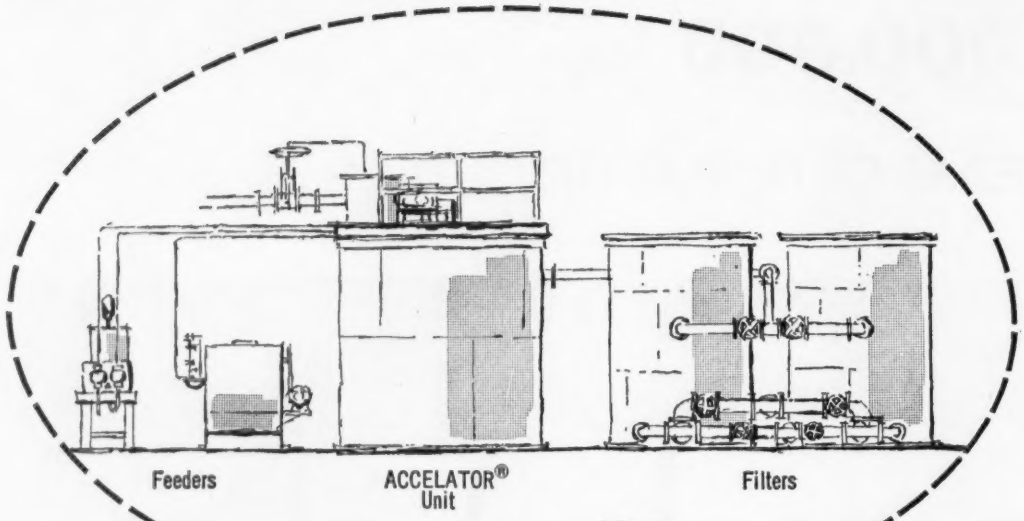

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plant

COMPLETE—from inlet to outlet—nothing else required.

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Write today for full details on the "ACCELAPAK" plant in Bulletin 1870-A or request Bulletin 80 showing our complete line of water and waste treating equipment.

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INFILCO Inc.
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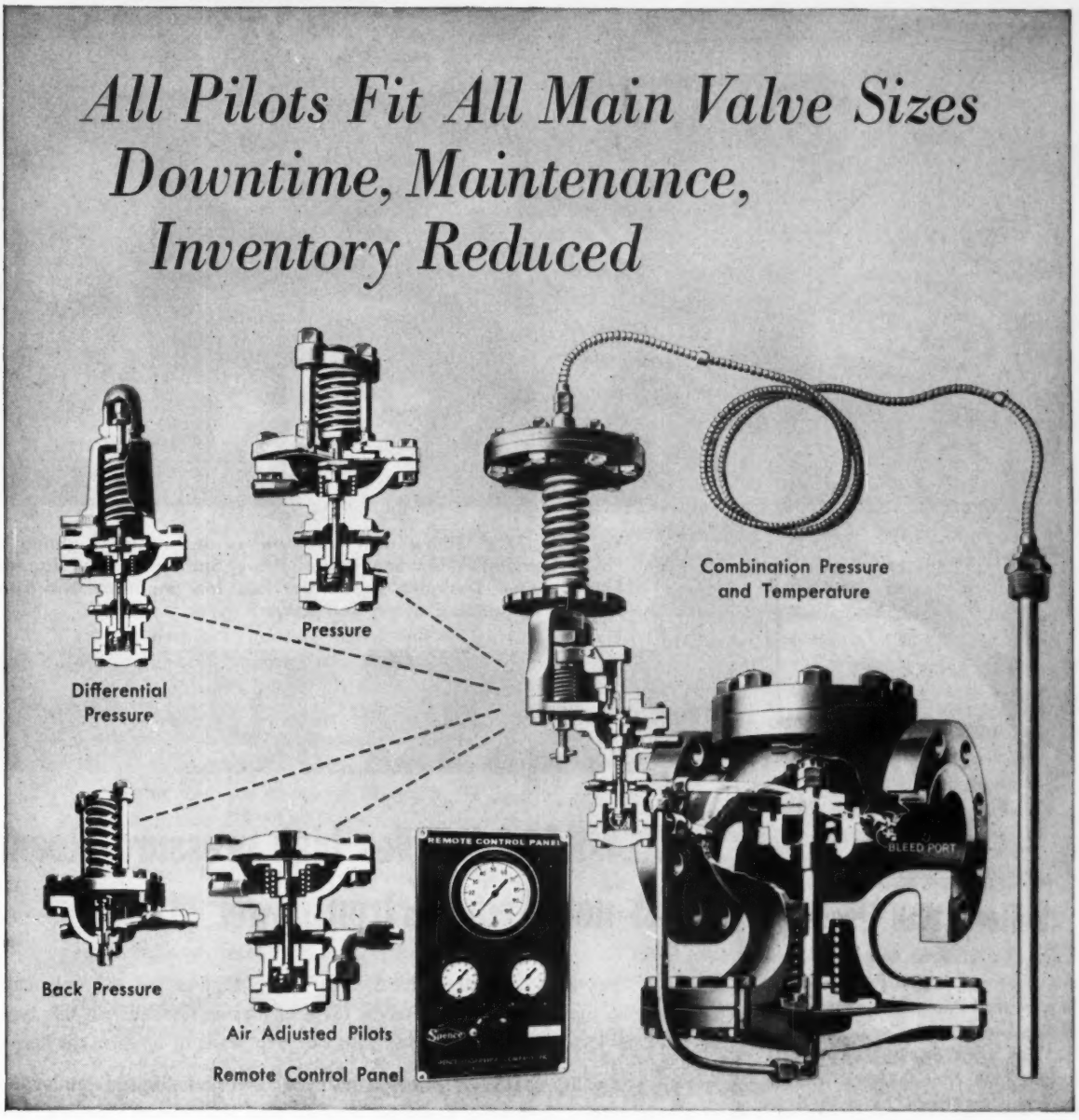
For more facts circle 231 on Reader Service card, p 97

All Pilots Fit All Main Valve Sizes Downtime, Maintenance, Inventory Reduced



Let's start off by admitting there's no such thing as a "maintenance-free" regulating valve. Any valve that automatically controls temperatures or pressures within close limits can be affected by dirt in steam lines.

If trouble does develop, engineers want a regulator they can get back on the line — fast. That's one reason why more engineers are standardizing on Spence Regulating Valves with externally mounted pilots. The simple test of disconnecting the external bends establishes whether the trouble is in the main valve or the pilot.

If the main valve is the trouble spot, it can be maintained without removing the valve body from the line. If the pilot is the trouble spot, it is easily removed for cleaning. However, if production downtime is a strong factor, the fastest method is to install a spare pilot and it is inexpensive.

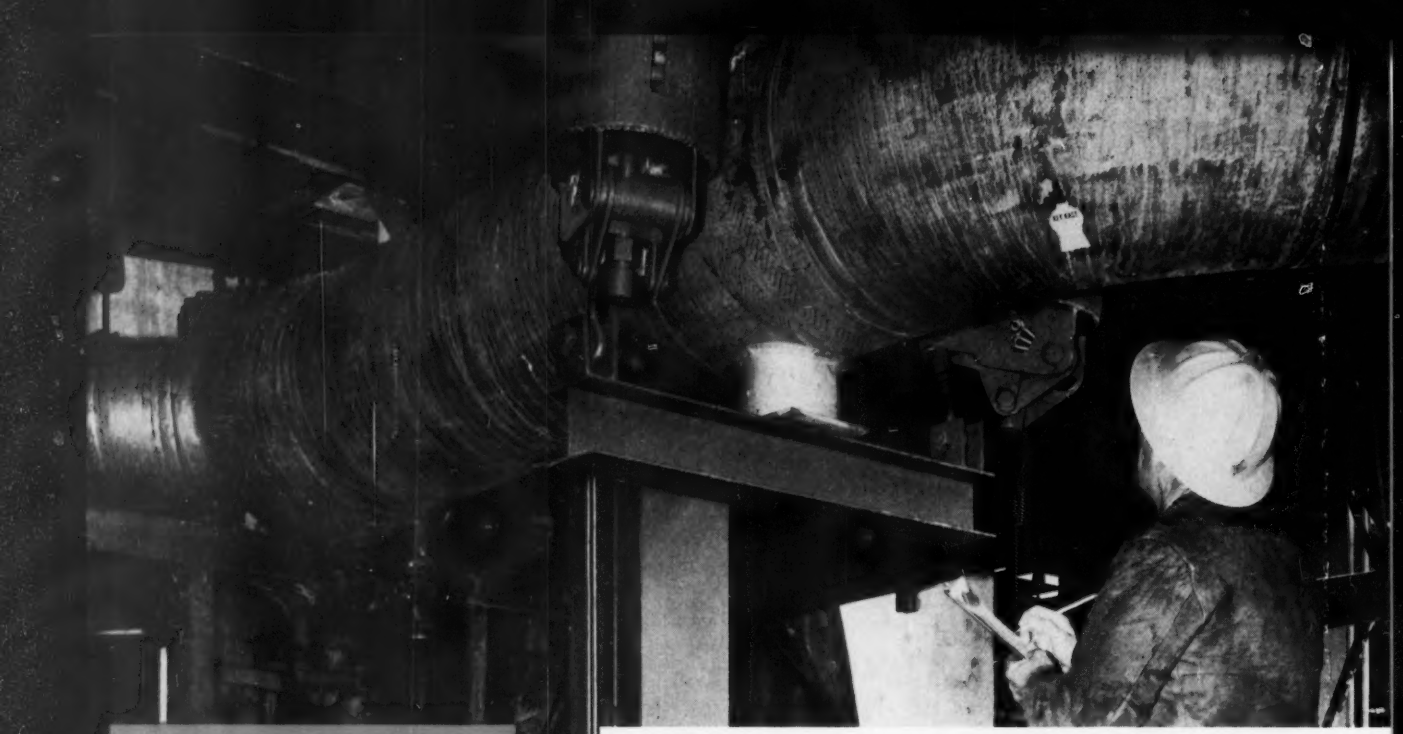
All Spence pilots fit all sizes of Spence main valves. If you have twenty pressure regulators, for instance, all you need is *one spare pilot*. It will fit all main valve sizes from ¼″ to 12″.

Another advantage of the Spence design is the external pilot is interchangeable. You can change the function of a regulator by merely changing the pilot. In many plants this can represent an important factor in reduced inventory costs because you only carry a few inexpensive extra pilots instead of complete regulators. Obviously, there is also a considerable savings in labor costs when a valve can be converted, in the line, from a temperature regulator to any one of various pressure regulators.

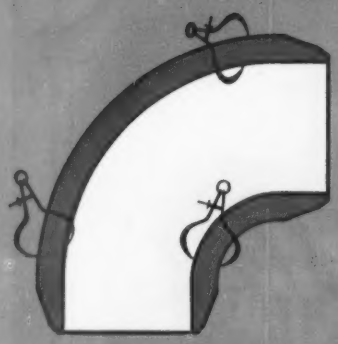
The pictures above show a few of Spence's wide line of automatic regulators. For more information write for Bulletin TE.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York 88-148

For more facts circle 227 on Reader Service card, p 97



Key-Kast 27½" elbow and wye fittings at Houston Lighting & Power Company's new Sam Bertron Power Station near the Houston Ship Channel. Designer: Ebasco Services, Inc. Engineers and Contractors: Benjamin F. Shaw Company.



Uniform Wall Elbows

Key-Kast Elbows have uniform cast steel walls approximately 15% heavier than the required minimum thickness of pipe walls of the same I.D. For extra highly stressed line sections, the wall thickness can be increased as much as desired — without sacrificing uniformity.

The flexibility of Key-Kast Elbows permits their use in piping systems based on the usual piping stress calculations. Write for engineering bulletin entitled "Key-Kast Welding Elbows in Piping Stress Calculations," and for W-K-M's Quality Control Specifications No. 102958 (conventional steam power) and No. 103058 (nuclear power).

Products of W-K-M's
Creative Engineering

KEY-KAST® handles high pressure steam at new Sam Bertron power station

Key-Kast *Uniform Wall* Steel Welding Elbows are the *only* cast elbows that meet all requirements for strength *and* flexibility in this type of service, and the *only* elbows with cast steel walls of uniform thickness.

Quality controlled through the most rigid metallurgical production and testing standards, Key-Kast Fittings meet ASTM specifications, and ASME and ASA code requirements.

Call your Key-Kast representative for prompt, experienced service in selecting the Key-Kast Fitting best for you. Available in all standard shapes, sizes and schedules . . . or specially designed to meet specific conditions of pressure, temperature and lading. *W-K-M Division of ACF Industries, Incorporated, P. O. Box 2117, Houston, Texas.*

Key-Kast Fittings can handle **any** piping job. Specify them. You'll get outstanding service.

W-K-M
SERVING INDUSTRY 40 YEARS

5902

LOUIS N ROWLEY, EDITOR • AUGUST 1959 • ESTABLISHED 1882 **Power**

Machine tools and kilowatts

I have never had any doubts about the growth prospects for the U. S. electric power industry, but if I had, they would have been conclusively laid to rest by recent visits to the turbine-generator shops of General Electric and Westinghouse. Each of these companies has sized up the demands that will be made on its manufacturing facilities in the 1960's and each is investing many millions to be ready to build more and bigger units, and to do the job faster and more efficiently.

To those who think of automation as something peculiar to the mass-production industries, a tour of GE's turbine shop is a literal eye-opener. Here one can see a newly installed horizontal 4-turret unit designed to drill, ream, or mill the thousands of openings that provide cooling paths in giant generator rotors, and do it all under control of a perforated paper tape. From the directions embodied in stacks of punched cards, another new machine automatically carries out 250 operations to form the conductor bars for inner-cooled generators.

Perhaps most uncanny of all the new automated tools is a unit that machines the complex contours of large turbine buckets as directed by invisible signals on magnetic tape—signals that are derived by computer wizardry from the original engineering designs.

At Lester, Pa., Westinghouse is embarked on a $21 million modernization that will increase facilities for manufacture of turbine-generators and heat-transfer apparatus by approximately one-third. In this 2-year program, new and sophisticated machine tools will be integrated into a rearranged layout that will greatly improve manufacturing flow and boost the plant's production efficiency.

In these shops, and many others where advanced methods are being applied to manufacture of power equipment, a visiting engineer can spend fascinated hours exploring the mechanical and electronic marvels of today's tooling. But, interesting as it may be, technique is not our main concern here, nor is it anything but a means to an end for the turbine builders who are investing millions of dollars in new methods.

At both GE and Westinghouse, manufacturing engineers have painstakingly analyzed the costs of new machine tools and methods and have compared them with the performance gains: sharp increases in productivity, substantial saving in manufacturing time, new high standards of precision, and, in some cases, the ability to do jobs that just couldn't be done before.

All these gains will be needed in the years immediately ahead. Average unit size today is in the 200,000-kw range, but at the end of the next decade it will probably be 400,000. Largest unit on order today is a 500,000-kw GE machine, but Westinghouse has just offered an 800,000-kw turbine generator to TVA, and the million-kw unit isn't too far in the future. Along with these increases in unit size, the 1960's will see an increasing number of designs for higher steam conditions, particularly for supercritical pressures.

These bigger, more-efficient generating units are a reflection of the task that lies ahead for the electric utilities—*the addition, during the 1960's, of at least as much capacity as is now operating.*

And major modernization investments by equipment manufacturers are a reflection of their determination to be ready to meet utility company demands, promptly and economically.

GENERAL CONTRACTORS: Campbell Construction Co., Detroit, Mich.
ARCHITECT & ENGINEERS: Campbell Engineering Co., Detroit, Mich.
ELECTRICAL CONTRACTOR: Southeastern Electric Co., Detroit, Mich.

Electrical Protection goes MODERN *with* BUSS Fuses

in the Hoover Tool & Die Co., Centerline, Mich.

This new industrial plant on the outskirts of Detroit illustrates that the modern trend in electrical protection is to fuses. The main switch gear is a 1600 ampere pressure switch protected by BUSS Hi-Cap fuses. The distribution panels, both power and light, are equipped with FUSETRON dual-element fuses.

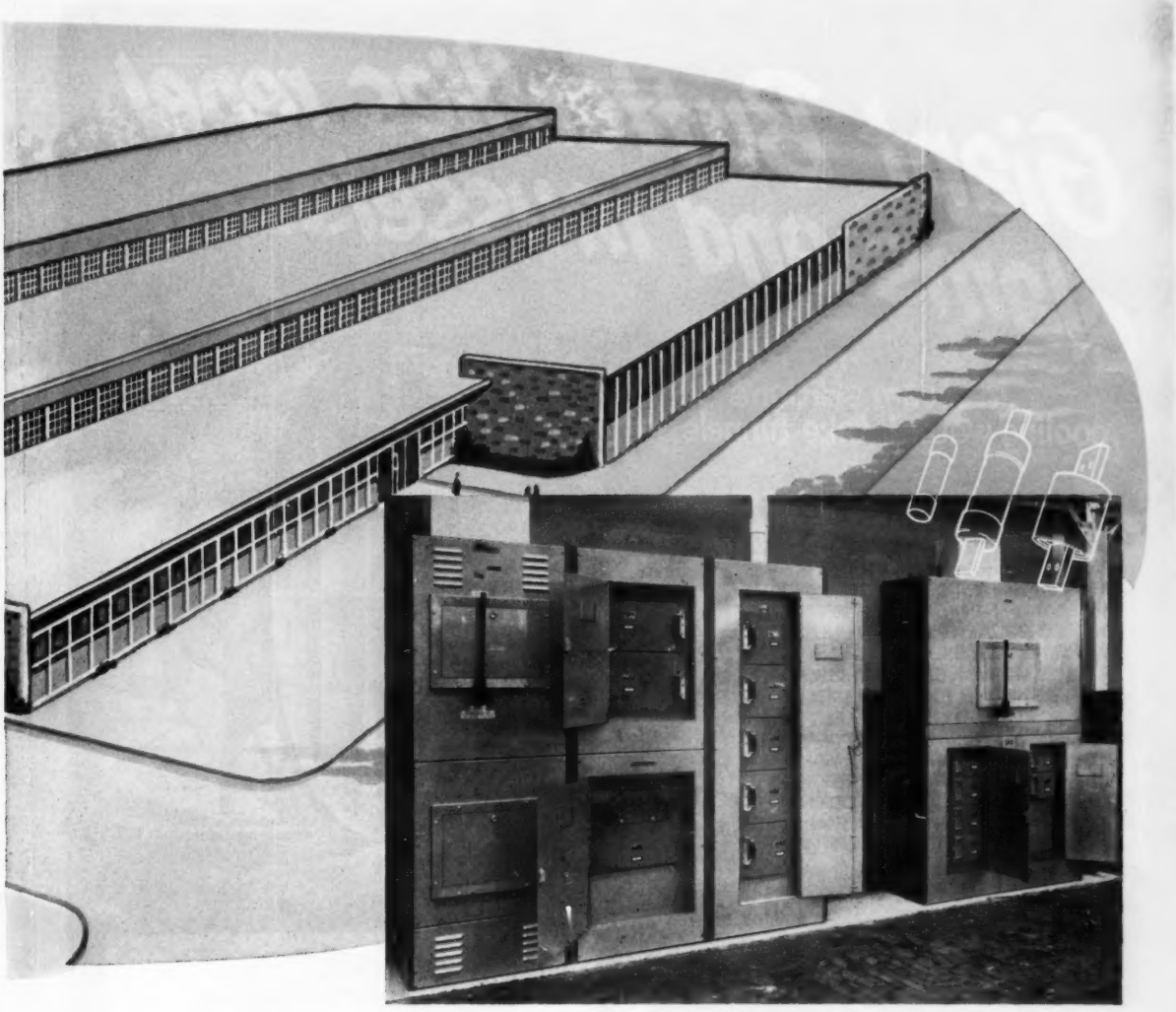
This plant will have many operating advantages because fuses are installed. *For instance:*

Future expansion without sacrificing safe protection.

Provisions were made to install a second 1600 ampere pressure switch when needed. This additional capacity and any increase in available fault current can safely be handled by BUSS Hi-Cap and FUSETRON dual-element fuses.

The interrupting rating of BUSS Hi-Cap fuses is 200,000 amperes rms symmetrical — and for FUSETRON fuses it is 100,000 rms symmetrical.

ANOTHER BUSS HI-CAP AND FUSETRON FUSE INSTALLATION



Main Power Panels —
BUSS Hi-Cap and FUSETRON Fuses

Through the year's savings result from the greater dependability of fuses.

Unlike mechanically operated devices, a fuse has no hinges, pivots or contacts to stick or get out of order. Dust, fumes, corrosion or age cannot increase a fuse's capacity or lengthen its blowing time.

After years of service, a fuse will give the same safe, dependable protection if called upon to open as it would have given on the day it was installed.

The dependability of BUSS Hi-Cap and FUSETRON fuses helps to reduce costs — by preventing damage and loss due to electrical faults — by being maintenance free — by requiring no periodic inspections — and by eliminating shutdowns caused by needless outages.

Is it any wonder then that "ELECTRICAL PROTECTION IS GOING MODERN WITH FUSES"? No other type of protective device can match the combined high-interrupting capacity, dependability and maintenance-free features of fuses.

For more information

On BUSS Hi-Cap fuses . . . . *Write for bulletin HCS*

On FUSETRON dual-element fuses . . . . *Write for bulletin FIS*

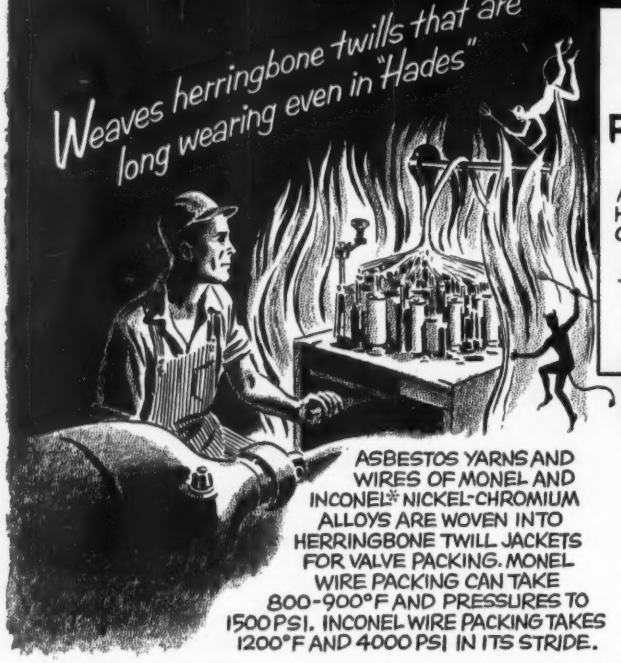
BUSSMANN MFG. DIVISION, McGraw-Edison Co. ST. LOUIS 7, MO.

For more facts circle 229 on Reader Service card, p 97

Giant Butterflies repel clams and mussels...

in steam station's cooling water intake tunnels

COLONIES OF MARINE GROWTH COULD EASILY ENCRUST AND CHOKE THE INTAKE OCEAN PIPELINES OF COASTAL STATIONS. ONE STATION NOW DISCOURAGES THESE MARINE SQUATTERS BY AN UNUSUAL REVERSING CONDENSER COOLING WATER SYSTEM THAT WILL SEND HOT DISCHARGE WATER DOWN THE TUNNEL! HEART OF THE SYSTEM ARE FOUR 132" PRATT BUTTERFLY VALVES OF MONEL* NICKEL-COPPER ALLOY. MONEL ALLOY ASSURES PERMANENT, EFFICIENT OPERATION. IT RESISTS CORROSION BY SEA WATER... EROSION BY THE 400,000 G.P.M. OF PACIFIC OCEAN WATER PASSING THROUGH EACH GIANT VALVE.



Weaves herringbone twills that are long wearing even in "Hades"

ASBESTOS YARNS AND WIRES OF MONEL AND INCONEL* NICKEL-CHROMIUM ALLOYS ARE WOVEN INTO HERRINGBONE TWILL JACKETS FOR VALVE PACKING. MONEL WIRE PACKING CAN TAKE 800-900°F AND PRESSURES TO 1500 PSI. INCONEL WIRE PACKING TAKES 1200°F AND 4000 PSI IN ITS STRIDE.

Fingers that can't get burned!

AS THIS QUICK-ON, QUICK-OFF COUPLING GETS HOT, INCONEL "X"* AGE-HARDENABLE NICKEL-CHROMIUM ALLOY "FINGERS" EXPAND TO GRIP HARDER, SEAL TIGHTER AND TIGHTER. THE SUPERIOR SPRING PROPERTIES OF INCONEL "X" ALLOY ASSURE LEAKPROOF OPERATION FROM -320° F TO +1750° F... FROM 0.8 MICRONS VACUUM TO 8000 PSI.

SLOWED DOWN BY A METAL PROBLEM?

A TALK WITH ENGINEERS FROM INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU GET BACK ON SCHEDULE. JUST GET IN TOUCH WITH US AND OUTLINE THE DETAILS. AND FOR A USEFUL RUN-DOWN ON MONEL ALLOY, WRITE DEPARTMENT P FOR 30-PAGE INCO BULLETIN, "ENGINEERING PROPERTIES OF MONEL AND 'R' MONEL ALLOYS."

THE INTERNATIONAL NICKEL COMPANY, INC.
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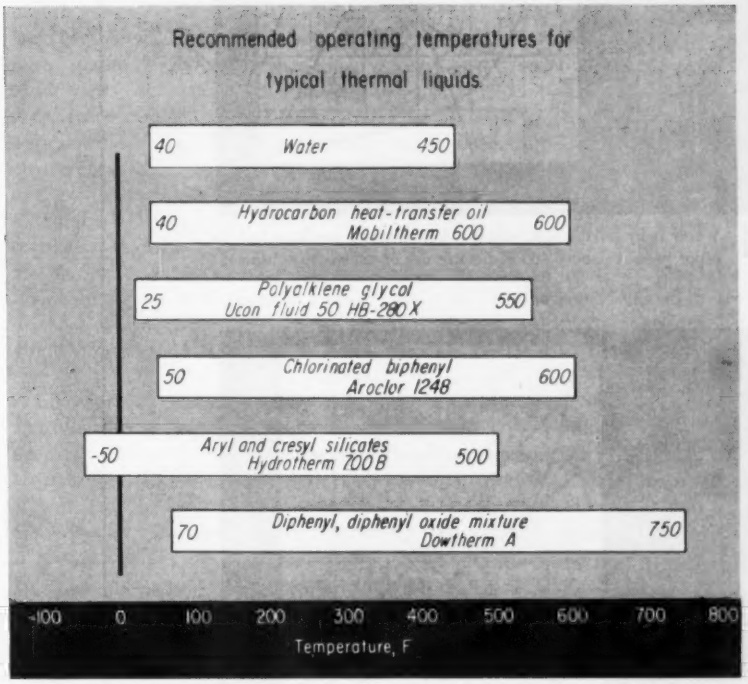
INCO NICKEL ALLOYS

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge


Recommended operating temperatures for typical thermal liquids
40 Water 450
40 Hydrocarbon heat-transfer oil Mobiltherm 600 600
25 Polyalklene glycol Ucon fluid 50 HB-280 X 550
50 Chlorinated biphenyl Aroclor 1248 600
-50 Aryl and cresyl silicates Hydrotherm 700 B 500
70 Diphenyl, diphenyl oxide mixture Dowtherm A 750
-100 0 100 200 300 400 500 600 700 800
Temperature, F

OPERATING LIMITS are being pushed wider apart as new thermal liquids are developed

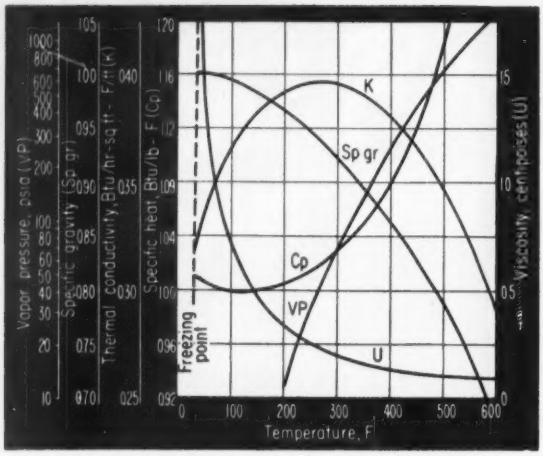
Thermal liquids match process heating needs

With process industries calling for higher temperatures the liquid heat carriers are offering a host of operating and maintenance benefits without use of high pressures

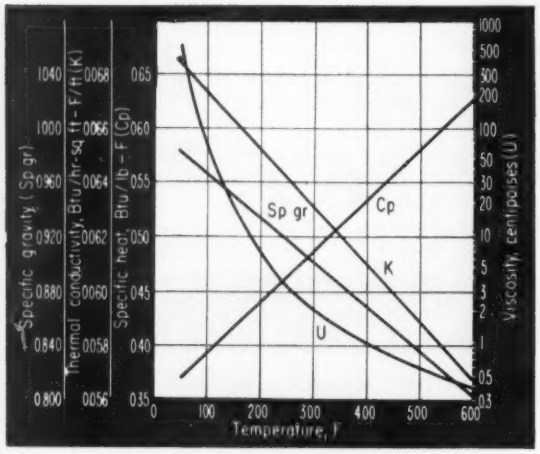
By R C BELLAS
Associate Editor

From open flame—to steam—to thermal liquids is, in brief, the history of process heat transfer. Unhappy with early, direct-fired equipment, engineers separated fire from equipment, used steam to bridge the gap. But as processes demanded more and more heat, steam's zooming pressure curve made equipment elaborate and costly. One answer: Today's thermal liquids, which are making new processes possible, raise profits above existing systems.

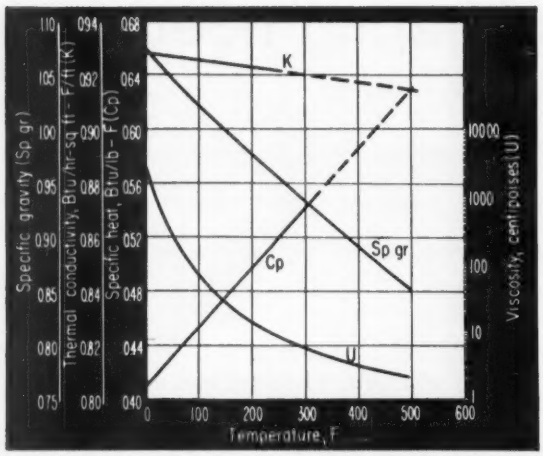
Turn page ►



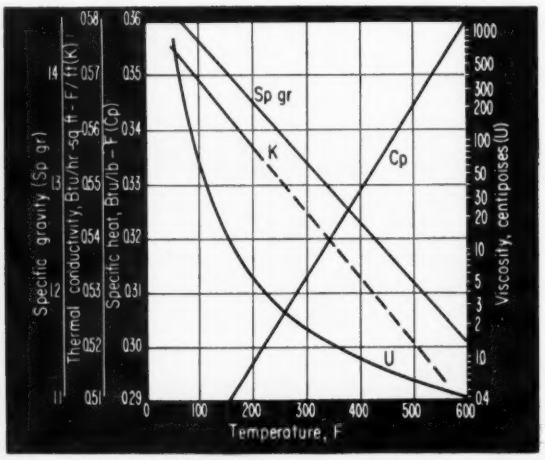
1 Water is by far the most efficient heat-transfer medium, but its vapor pressure above 400 F dictates use of expensive equipment



2 One of the fire-resistant hydrocarbon heat-transfer oils, *Mobiltherm 600*, can be used at temperatures up to 600 F at zero psig



3 A polyalkylene glycol, Union Carbide's *Ucon Fluid* has high flash and fire points, is suitable up to 550 F in liquid phase



4 Monsanto's *Aroclor 1248*, a chlorinated biphenyl, has properties making it desirable for use in systems subject to fire hazard

Here are the facts

Today's industrial processes are using high-temperature, low-pressure heat-transfer systems, both liquid and vapor phase, in greater numbers. Their applications are increasingly more diverse: from coffee, car polish and cooking oils; detergents and drugs; motor oils and metalworking; paint, potato chips and plastics to shortening and soaps and many others. Some of these processes get by very well with temperatures not over 400 F. For these, steam (at a modest 230 psig) or one of a number of available heat-transfer oils may be used.

Process needs such as met in plastics production, requiring temperatures up to 750 F, are a horse of another color. Oils used in this range are apt to break down unless the heat carrier and system are specifically designed to do the job. What these thermal liquids are and how they can be profitably applied is well worth a hard look by plant management faced with a need for higher process temperatures, yet unable to budget for the high-pressure equipment dictated by a steam system.

What is a thermal liquid? Technically, any liquid capable of use as a heat vehicle falls into this category. In the heat-transfer busi-

you should know before selecting thermal liquid

ness, though, it's one of the commercially available fluids costing from $1 to $30 per gal. Beginning with water, for comparison, here's a brief rundown on the field.

Water, Fig. 1, actually is by far the best heat carrier of all those available. Its specific heat (heat-carrying ability) and its latent heat of vaporization (heat given up in condensing) are exceptionally high. It lends itself nicely to high-output compact-unit designing and it's relatively cheap; there's no harm done if you spill a little. But when you ask it to carry higher temperatures (above its boiling point of 212 F), be ready to supply comparatively expensive equipment to contain its vapor pressure. This goes from 52 psig at 300 F, to 121 psig at 350 F, to 230 psig at 400 F, climbs to 685 psig at 500 F and zooms to 1585 psig at 600 F. If your process must have 700 F, be prepared to handle vapor pressure at about 3000 psig. To disadvantage of high pressures, add water's general tendency toward scale formation and corrosion.

Now contrast water's pressure-temperature relationship with that of the heat-transfer oil shown in Fig. 2. A hydrocarbon, it's Socony Mobil's *Mobiltherm 600*. It is resistant to high temperatures, can be used at up to 600 F without thermal cracking or pressure buildup above atmospheric. This aromatic heat-transfer oil has good viscosity characteristics at temperatures below 100 F and, at the other end of the scale, will maintain its flash point practically unchanged after years of operation. Manufacturer recommends use in closed, but unpressurized system with forced circulation.

Fig. 3 shows physical properties of a polyalkylene glycol, known commercially as Union Carbide's *Ucon Fluid 50-HB-280X*. Another liquid-phase heat-transfer medium, it's suitable for operating temperatures up to about 550 F at zero operating pressure. It has high flash and fire points.

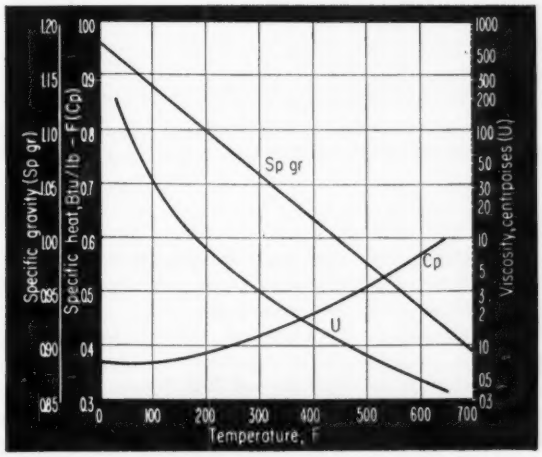
Chlorinated biphenyl, shown in Fig. 4, can be operated in unpressurized systems up to 600 F; somewhat higher if system is specially designed. This fluid, Monsanto Chemical Co's *Aroclor 1248*, has the advantage of being highly fire resistant, finds considerable application in processes where fire is a constant hazard. It can be circulated by centrifugal pump at temperatures as low as 50 F.

The silicate family provides heat-transfer fluids which are used in liquid phase and at negligible vapor pressure at temperatures up to 750 F. One of these fluids, American Hydrotherm Corp's *Hydrotherm No. 750*, is shown in Fig. 5. The silicate group's low viscosity characteristics, high fire points and high specific heats make these fluids suitable for many heat-transfer applications.

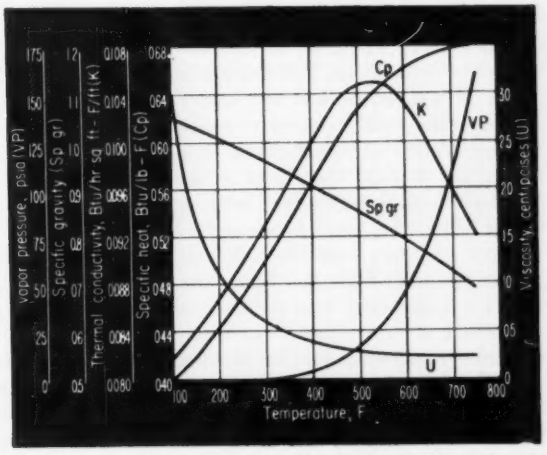
Up to this point discussion has been limited to those heat-transfer media used only in liquid phase. In Fig. 6 we have properties of a diphenyl, diphenyl-oxide mixture, Dow Chemical Co's *Dowtherm A*, which can be used either in liquid or vapor phase to transfer heat. By and large it's used in the vapor phase in the majority of heating installations. At room temperature *Dowtherm A* is a clear, almost colorless liquid, which darkens rapidly in use, has a characteristic rose-geranium odor. Its working range is 450 to 750 F, with vapor pressures of up to 145 psig.

As with practically everything else in life, diverse opinions exist with respect to liquid-phase vs vapor-phase heat transfer. Unquestionably, both systems do an efficient job; they have some advantages and disadvantages relative to each other. Perhaps the major operating difference involves heat-generator design. Let's take a look at some of today's typical units.

Turn page ▶



5 Different from one listed on p 53, this silicate fluid is American Hydrotherm's *No. 750*, has no operating pressure at 750 F



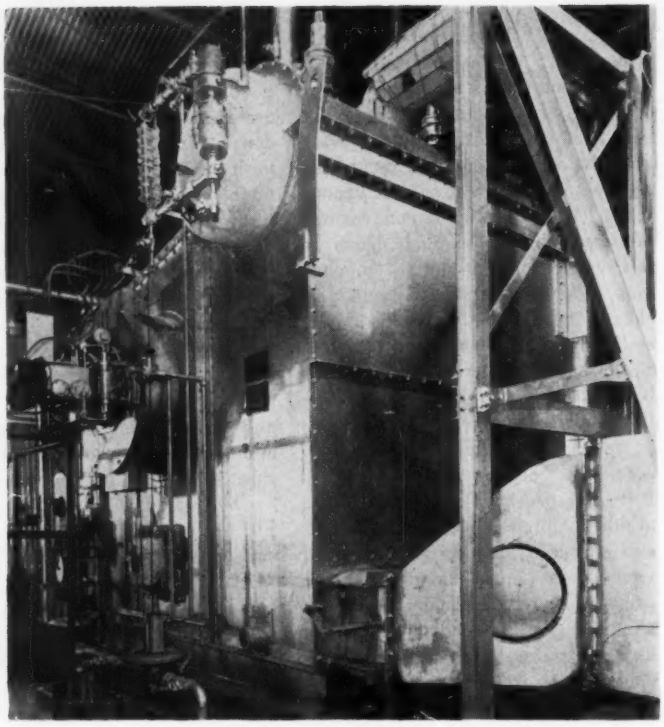
6 For vapor-phase systems Dow Chemical's *Dowtherm A*, a diphenyl, diphenyl-oxide mixture, provides 750-F at 145 psig

Heater may be a conventional boiler for vapor phase

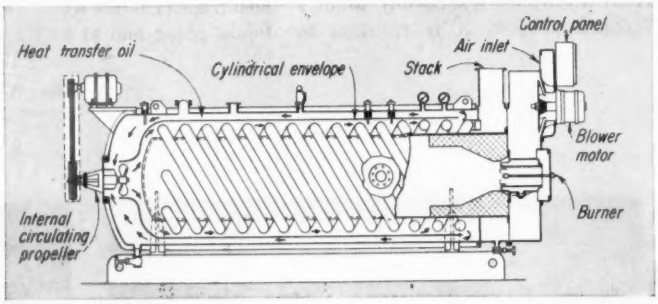
In the early 1930's, a vapor-phase heat-transfer concept was proposed by Dow Chemical Co to produce a higher heat-absorption efficiency than available from direct-fired equipment, yet avoid the high pressures associated with high-temperature steam. Compound selected, a diphenyl diphenyl-oxide mixture known commercially as *Dowtherm A*, has a working range from 450 to 750 F at pressures up to 145 psig.

Shortly after introduction of *Dowtherm A* to the process industries, another fluid was developed to meet a demand for a heat-transfer medium to fill the gap in the 300- to 500-F temperature range. This fluid, known as *Dowtherm E*, is a purified o-dichlorobenzene stabilized for heat transfer. Both of these fluids convert to vapor just as water converts to steam, and in equipment practically identical to that used with water. Terminology differs; steam is generated in a boiler while *Dowtherm* liquids use what's known as a vaporizer. But here the similarity ends because, for example, steam at 700 F exerts about 3000-psi pressure while *Dowtherm A* exerts only 95-psi pressure at this same temperature. Obvious advantages: (1) Expense and possible hazards of high-pressure equipment are eliminated and, (2) more important, desirable designs not economically feasible when built to withstand steam pressure are possible.

Though *Dowtherm* fluids are used either in liquid or vapor phase to transfer heat, majority of installations are vapor phase. Reason: Aside from industry's demand for higher process temperatures which would indicate choice of *Dowtherm A* over *Dowtherm E* (and *Dowtherm A* has a somewhat objectionable freezing point of 53.2 F), vapor-phase is considered generally superior to liquid-phase heating. With the latter, the liquid's temperature must decrease as the result of heat release. Too, heat-transfer coefficients for the liquids may be lower than those for the condensing vapor. In the final analysis, individual process circumstances determine heat-transfer medium and whether it is liquid or vapor phase.



7 Vaporizer, *above*, is similar to a steam boiler operating at modest pressures, has modified accessories. Condensate return may or may not need a pump

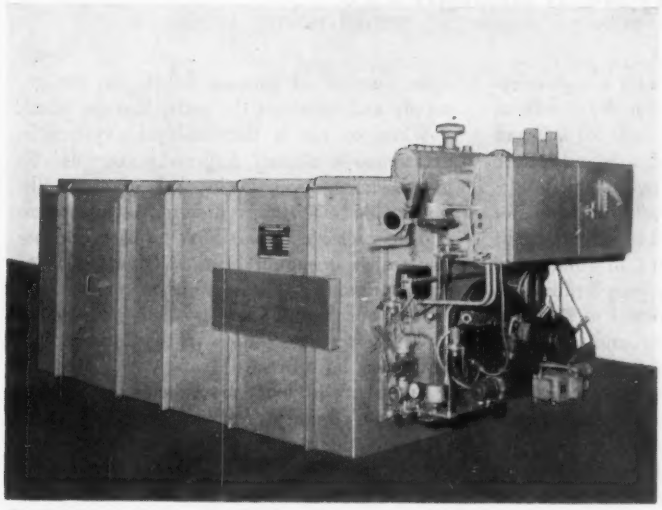


8 Forced circulation in this liquid heater is maintained with internal pump, *left*. Result: an effective means for preventing overheating within the unit

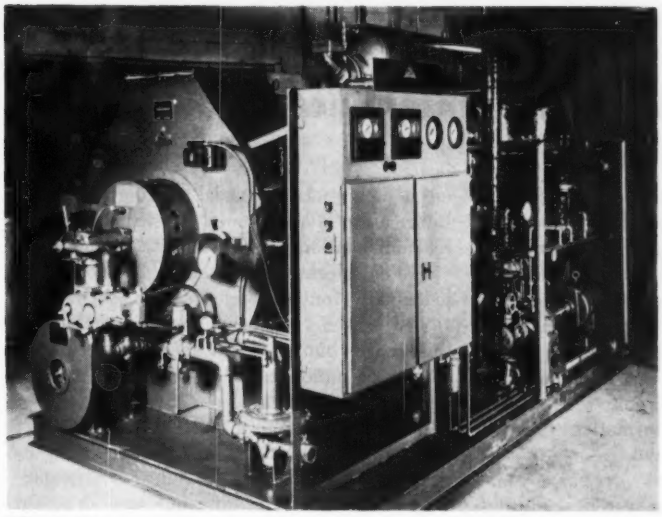
Typical heating system for *Dowtherm* involves a vaporizer, process equipment, instrumentation and accessories. Natural circulation throughout entire system is possible if location of process equipment in which vapor condenses permits gravity return of condensate to the vaporizer. Such a system is closed, contains no moving parts. Where gravity flow can't be used, condensate pumps are added to the system to return fluid to the vaporizer.

Thermal efficiencies of *Dowtherm* vaporizers are about 60% for firetube and 70% for watertube units, which are comparable to steam-generator efficiencies under similar operating conditions. Air preheater alone can up efficiency because *Dow-*

but liquid-phase system must use a forced-circulation unit



9 LaMont type forced-circulation thermal-liquid heater has small-diameter tubes of equal length, orificed for uniform flow and even temperatures



10 Both temperature and pressure are sensed in this liquid heater to modulate burner firing as a constant guard against overheating of fluid and parts

therm's high temperature limits stack gas temperature. Since condensate normally returns to the vaporizer at saturation temperature, economizers can't be used.

Dowtherm vaporizers, though quite similar in design to steam generators, have modified accessories (gage glasses, safety valves, etc) to compensate for nature of material being handled. Photo, Fig. 7, shows a typical unit, one of many designs for vapor-phase heat-transfer service. Available too are firetube designs specifically modified to deliver top performance in this field. Both watertube and firetube units can be equipped with completely automatic controls. Added advantage is that vaporizers' low operating pressure may exclude them from regulations requiring licensed boiler operators.

Liquid-phase heat-transfer systems were developed to provide similar high process temperatures, but at little or no operating pressure. These systems have enjoyed a considerable degree of success. As indicated on the previous pages, a number of liquid-phase heat-transfer media are available and selection must be based on operating conditions desired for the process. However, all these thermal liquids present one problem in common: potential thermal breakdown of the fluid.

Prevention of thermal breakdown, a major problem, dictates that extremely careful attention be given to entire system design and liquid-heater selection. Breakdown will occur in the fluid portion subject to temperature above its decomposition point. In the heater, fluid most subject to decomposition is the film closest to the flame. It follows then that to operate at highest permissible mass temperature, the temperature drop across the film must be kept low by keeping liquid velocity high across the heat-absorption surfaces. This means that the forced-circulation type heater is a must for these fluids.

Photo, Fig. 9, shows a watertube unit widely used as a liquid heater and one which is typical of good design for this service. It has a number of parallel, small-diameter tube circuits orificed to give high-velocity fluid flow and spaced to permit uniform heat absorption.

Important feature of the firetube unit illustrated, Fig. 8, is its integral circulating propeller giving forced internal circulation. This propeller insures positive circulation to protect the fluid from overheating even if fluid flow is interrupted in the external system.

Relatively new design, Fig. 10, is a forced-circulation heater with integral heat exchanger for steam production. Though many liquid- and vapor-phase heat-transfer systems include exchangers to produce steam for space and process heating, this unit appears to be the first to incorporate an exchanger within itself.

Turn page ▶

Get the best thinking on system design . . .

Designing a system for use with a high-temperature, low-pressure heat-transfer medium, either vapor or liquid phase, calls for a brand of know-how that differs significantly from that needed for steam heating-system design. Over the years in which these heat-transfer fluids have become more and more important to an increasing number of industrial processes, this know-how has been building up to an impressive level. Producers of the heat-transfer agents, liquid-heater and vaporizer manufacturers and manufacturers of other system components, controls and accessories have dovetailed research and development efforts and swapped experiences.

A number of consulting engineers, thoroughly conversant with the chemical, physical and thermodynamic properties of these heat-transfer media, stand ready to supply their services. Some, experienced in a wide number of process fields, can design, supply and construct the entire thermal plant.

When to use a thermal-liquid system in preference to steam? Experts' consensus: So many variables creep in that it's virtually impossible to pin down a definite temperature above which steam shouldn't be used and below which it should be used. Best bet is to make pressure the governing factor. Neither vapor- nor liquid-phase systems are meant to usurp steam's position in the low-temperature (and low-pressure) range.

But where higher temperatures are needed, and steam's higher pressures begin to present problems, it's time to think seriously of a change. In general, where steam is available it can be used until temperature demand moves above 400 F. Where new heat-generating equipment is needed, a thermal liquid may be advisable for temperatures above 350 F.

. . . then follow up with planned maintenance

Operating and maintaining a thermal-liquid system in top-flight condition is fundamentally no different from keeping a steam system, or any other equipment, in good shape. It's simply a matter of knowing as much as possible about the system and giving it enough attention. So far as learning about the system is concerned, manufacturers of all components down to the last nut and bolt will gladly supply enough detailed information to saturate any operator with knowledge.

Practically all installations are gas or oil fired and burners and combustion controls are basically the same as with a steam boiler. Safety devices, such as relief valves on a vaporizer, may be modified to suit the heat-transfer medium being handled. Some may be a departure from those common to a steam plant. One example is steam or inert-gas smothering line running to the vaporizer's combustion space. Knowledge of devices' function, necessary maintenance and testing is extremely important to any system's well-being.

Vapor-phase systems may or may not include pumps, liquid-phase systems always use one or more. Such pumps are specially designed for high-temperature service, have water-cooled bearings and stuffing boxes, use mechanical seals or special packing materials. Lubrication is a fine point; system designer's recommendations should be strictly followed.

System leakage shouldn't be tolerated, principally for economic reasons. A well-designed system won't give much trouble on this score, but if maintenance ignores miscellaneous minor leaks which develop in service, overall effect can be costly.

Most important factor of all, and it can't be over-emphasized, is preventing the heat-transfer medium from being overheated. Vaporizers and liquid heaters are designed with care to avoid localized overheating in normal operation. But the designers can't control a system operator who pushes the heat-transfer medium above its recommended maximum operating temperature, may cause it to decompose completely. And, speaking of decomposition, some will occur together with some contamination over a period of time. How much depends, of course, on degree of departure from normal operation. Some systems have been in service for almost ten years, still show no significant deterioration. But, if and when fluid decomposition affects its performance, suppliers provide fast, low-cost reprocessing service.

Capacitors, properly applied, can help you avoid power-factor penalties, release system capacity, improve voltage and reduce losses

Locate your power-factor capacitors where they'll save the most dollars

By G R MENKART, General Electric Company

Capacitors give you maximum benefits when they are installed close to individual low-power-factor loads in an industrial plant. However, load terminals are not always the most economical location. Alternate locations for capacitors include utilization buses, points close to service entrances or at the substation on either the primary or secondary side of the transformer.

Two steps which will help you select the right capacitor locations and choose the right capacitor are:

(1) Find the value of benefits which capacitors can produce at various locations. Table, next page, shows how you can expect location to affect capacitor benefits.

(2) Compare the installed cost of capacitors at the various locations to the benefits they produce.

Benefits to a plant distribution system can be obtained from capacitors in four ways; they can reduce power costs, release system capacity, improve voltage levels and reduce system losses.

Reduced power billing. Utilities that serve industrial loads generally find it necessary to charge for reactive power or kilovars. The charge may be an adjustment in the power bill based on power factor, a kva-demand charge or a kvar-demand charge.

The charge can be reduced or eliminated if kilovars are furnished by capacitors installed on the distribution system. Often power companies will help the plant engineer estimate savings that capacitors can produce.

Increased load-serving ability. Both power producing current (kw) and magnetizing current (kvar) are required by most loads in a factory. These two components make up the total current (kva). When magnetizing current (kvar) is furnished by capacitors close to the load, the system is relieved of this burden. Capacitors on the load side of the transformer reduce kva load served by the transformer. Installed at the end of a feeder, capacitors can reduce current flow through it. By reducing or eliminating magnetizing current or kvar supplied through transformers and feeders, capacitors permit more power-producing current or kw to be served by these system components. Therefore, installation of capacitors can often help eliminate need for more transformers and additional feeder capacity, or both, when plant load is increased by new production machinery.

Reduced power losses. A portion of the input to an industrial plant is dissipated by losses because of current flow through the distribution system. These losses are proportional to current squared. Capacitors, by reducing current, also reduce power losses. Because losses occur in every part of the distribution system, maximum loss reduction will result when capacitors are installed at the load. However, loss reduction is often difficult to evaluate because most plants do not measure the amount of electrical energy purchased that is actually utilized. Nevertheless, loss reduction can be significant, and should be kept in mind when the time comes for you to consider alternate capacitor locations.

Improved voltage. Excessive voltage drop often occurs on plant distribution circuits with high reactance, such as old-style feeders with phase wires spaced far apart. On these high-reactance feeders, the application of capacitors can significantly reduce voltage drop and help keep voltage consistently high throughout the plant. Voltage improvement means better motor performance and an increase in overall plant efficiency.

Plants with modern electrical distribution systems are generally not troubled by excessive voltage drop, and its reduction will be a secondary capacitor benefit. In new plants the increase in voltage will generally be 2 to 3%, or about 10 volts, when capacitors are installed at the end of 480-volt system feeders.

Installed costs should be compared with benefits to determine the type and location of capacitors.

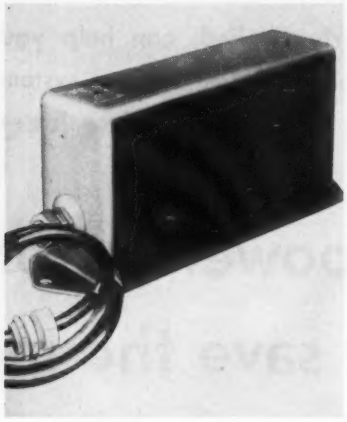
Capacitors at individual loads. Capacitors installed at, and switched with, individual loads such as induction motors produce maximum benefits and assure that kilovar supply automatically keeps pace with load requirements. Whenever a motor is running, a capacitor is on the line furnishing the kilovars which the motor requires.

continued

Capacitors are available today to fit needs

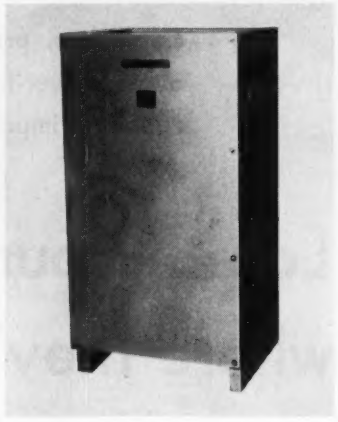
DUSTPROOF UNITS are suited for indoor installation at motor terminals. Various containers are available, some for hanger mounting and interconnection into banks

230 v—0.5 to 15 kvar, $39 to $17 per kvar
460 v—1 to 20 kvar, $19 to $8 per kvar
575 v—10 to 20 kvar, $19 to $8 per kvar



WEATHERPROOF AND DUST-TIGHT units are suitable for motor-terminal connection indoors and outdoors. Among containers available is one of 460 v with 4-ft leads

230 v—5 to 15 kvar, $25 to $17 per kvar
460 v—2 to 20 kvar, $22 to $8 per kvar
575 v—10 to 20 kvar, $11 to $8 per kvar



DUSTPROOF EQUIPMENT may be used indoors where a small block of kilovars is to be connected to main circuit. It can be applied at terminals of larger motors

230 v—30 to 120 kvar, $18 per kvar
460 v—40 to 240 kvar, $9 per kvar
575 v—40 to 240 kvar, $9 per kvar

Relative expected benefits from capacitors on different parts of typical plant distribution system

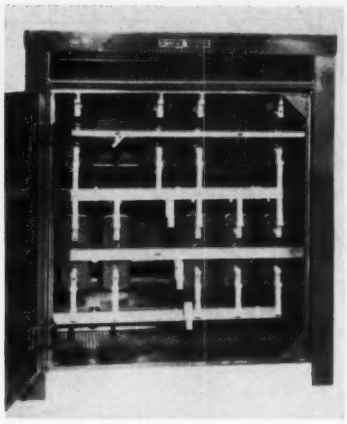
Capacitor benefit	Primary substation	Secondary substation	Feeder	Utilization bus	Load
Power bill reduction	0 or 100%*	100%	100%	100%	100%
Reduction in kva load on transformer	0	100%	100%	100%	100%
Reduction in kva load on feeders	0	0	50%	100%	100%
Reduced power loss in plant	0	15%	40%	80%	100%
Reduced voltage drop					
1. Transformer	0	100%	100%	100%	100%
2. Distribution circuits	0	0	50%	90%	100%

*Depending on where power is metered.

Two factors may discourage application of capacitors at the load. First, more capacitor kvar may be required than if capacitors were connected to some other part of the system. Second, smaller more-expensive capacitors may have to be used. For example, consider a plant load consisting of machinery driven by sixteen 20-hp 440-v induction motors. Nature of the work is such that only eight motors are running at any given operating time.

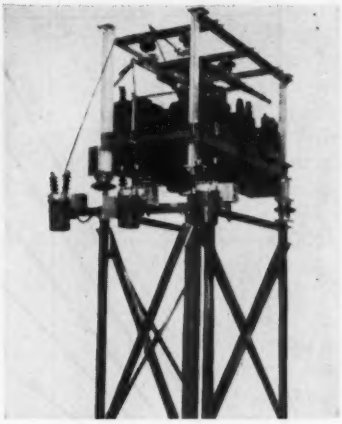
If capacitors are installed at the motor terminals, sixteen 5-kvar 460-volt units will be required. Cost of these capacitors is about $1230, or $15.40 per kvar. A relatively small unit, the 5-kvar capacitor has a high price per

of every location and operating condition



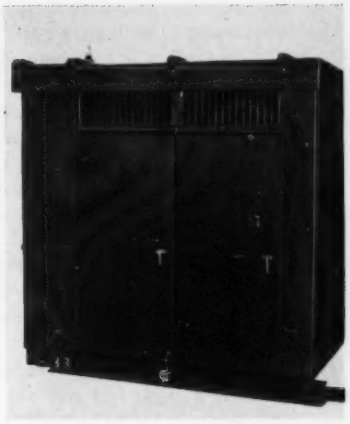
WEATHERPROOF, HOUSED, L-V assemblies are suitable for installation at larger loads, at substations or other locations outdoors. Some models can be used indoors

230 v—60 to 180 kvar, $19 per kvar
270 to 720 kvar, $20 per kvar
460 v—80 to 240 kvar, $10 per kvar
360 to 1920 kvar, $10 per kvar
575 v—80 to 240 kvar, $10 per kvar
360 to 2160 kvar, $10 per kvar



PRIMARY OPEN-RACK outdoor assemblies may be installed in substations on primary side of the transformer. They're available with three single-phase capacitor switches

2400 to 13,800 v—
600 to 1200 kvar, $6 per kvar



PRIMARY HOUSED EQUIPMENT can be applied in substations or other outdoor locations. Large housed equipment can be furnished with overhead entrance bushings

2400/4160 v—
45 to 180 kvar, $14 to $10 per kvar
4800/7200 v— 90 to 180 kvar, $11 per kvar
2400/4160 v— 1200 to 3600 kvar, $7 per kvar
4800/13,800 v—
1200 to 6000 kvar, $7 per kvar

kvar, as shown above. Because only eight motors will be running at any given time, 40 kvar of capacitors installed on utilization bus would provide same number of kvar on the line. Two 20-kvar capacitors, which together cost only $315, could be used. Cost of these two is slightly less than $8 per kvar. Therefore, a large number of small loads running intermittently generally make use of capacitors at load terminals uneconomical. Large motors, 25 hp to 50 hp or greater, running continuously or nearly so, favor application of capacitors switched with the load.

Capacitors on utilization bus. A utilization bus serving intermittent loads is a good location, particularly if capacitors do not have to be switched automatically. Most of benefits produced by capacitors at the load are obtained (often more economically) when capacitors are connected at the utilization bus. But if it is necessary to automatically switch capacitors at the utilization bus, then the cost of a switching device and controls may make it economically desirable to install capacitors at individual loads or at one large bank closer to the service entrance.

Capacitors on secondary of substation transformers. Capacitors installed close to a transformer that serves a plant reduce the number of individual capacitor banks. This may be desirable if it permits the installation of one capacitor equipment with one switching device, instead of several smaller banks scattered throughout the plant. Where the choice is between one unit rated 120 kvar or higher, and four or more smaller units, usually the larger unit at the substation will prove most economical. This is particularly true if the plant places a low value on reduced feeder loading, feeder losses, improved voltage.

When it is necessary to automatically switch all capacitors in a plant, a combination of capacitors switched with motors and a large automatically switched capacitor bank at the substation may afford the best solution, unless relatively large banks can be applied at the utilization bus.

Primary of substation transformers. Plants which purchase primary power may wish to consider installation of high-voltage capacitors. If open-rack equipments can be used, a primary capacitor application will generally afford the lowest installed cost per kvar. If the only benefit sought is a reduction in the power bill, the primary capacitors may be the answer.

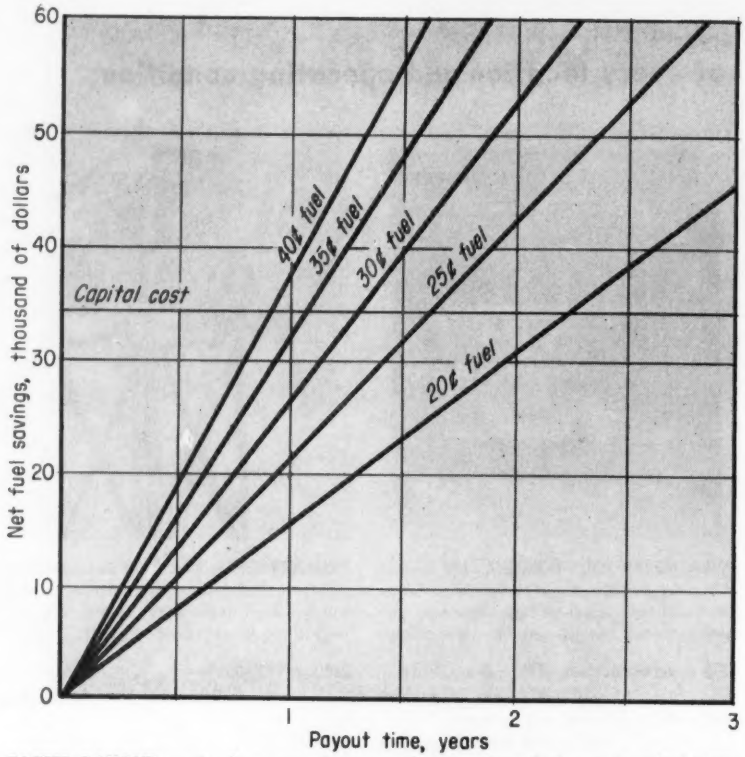
Best locations for capacitors depend on the load and the distribution system in a plant. Here are three general rules that you may use as a guide:

(1) Consider induction motors 25 hp or larger that run nearly continuously, as capacitor locations.

(2) Utilization buses are good locations for capacitors if the capacitors do not have to be switched automatically. If automatic switching is required, it is usually more economical to install one or two larger banks closer to the service entrance.

(3) Primary capacitors may prove best choice for plants that purchase power at 2400 volts or higher—if a reduction in the power bill is the only benefit sought.

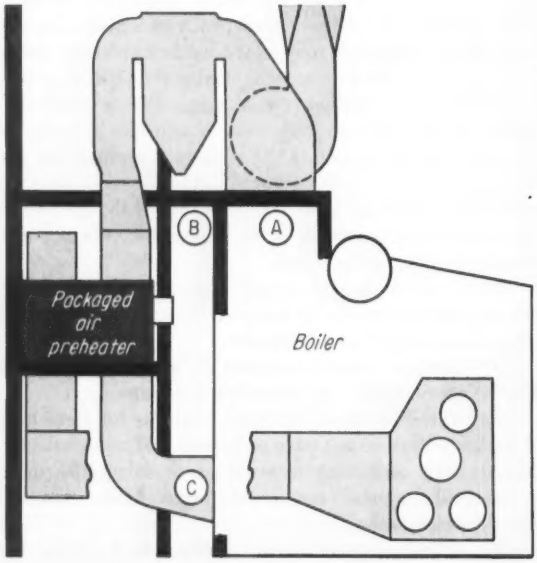
By C L BROWN, PE
Technical Consultant,
The Air Preheater Corporation



FASTER PAYOUT results from use of more realistic average fuel cost in calculations. Average cost picked from trend curve at right covers estimated life used in load figures

Fuel costs continue their upward climb. And this presents an important consideration when evaluating heat recovery equipment. Since capital charges are fixed, your economic evaluation depends on . . .

How rising fuel cost changes

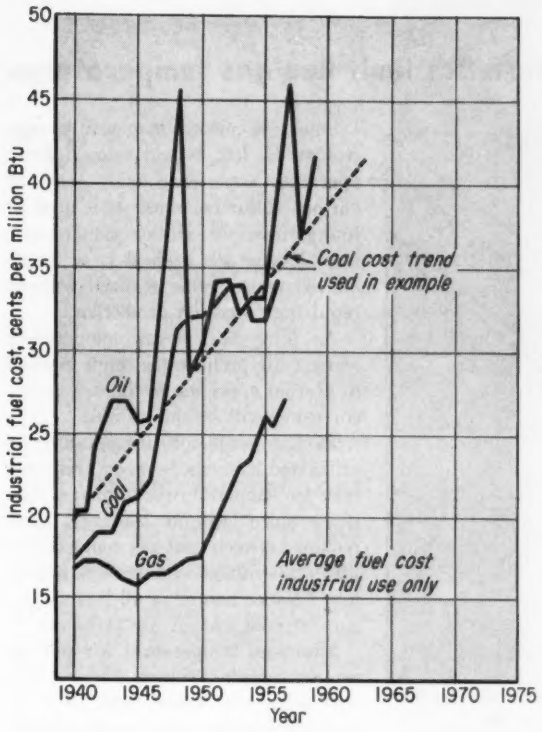


UNIT CONVERSION required moving boiler outlet from *A* to *C*. Use of dust collector without air preheater would move outlet to *B*

quipment payout rates are an important part of any decision to expand, modernize or modify industrial power services. This is particularly true of heat-recovery equipment since justification is usually on the basis of improved cycle efficiency rather than pure necessity. Many industrial plants have been unable to obtain needed equipment because payout rates did not quite fall within the 2-year maximum often used as a guide.

For those plants where new equipment evaluation may produce payout rates longer than justifiable, an apparent trend in evaluation methods may solve your problem.

Payout rates for heat-recovery equipment are usually figured on the basis of fuel-cost savings. By assuming an average load factor for expected life of the equipment and multiplying the average annual fuel saving by the present fuel cost, a gross fuel saving is estimated. Over the 20-odd-year life of the equipment, the average load may be estimated as one-half the maximum load. When applied with present fuel cost an unrealistic payout rate results. Latest trend in evaluation methods combines the average load with an estimated average fuel cost for one-half the expected life or longer. This places both the fuel consumption and the fuel cost on the same basis.



Fuel curves estimate future costs

Fuel-cost record shows price trend for industrial use only from 1940 on. Cost figures used are national averages for power-services consumption.

Estimated cost trends may be based on complicated economic analysis. However, a reasonable trend can be established by eye-averaging fluctuations for past years and extending a straight line as far into future as needed. Trend estimate used by International Paper Company appears as dotted line through coal curve.

Assuming 20-year life for the equipment, the trend line was extended beyond the one-half life point. Average coal cost for that 10-year period was about 35c per million Btu.

If local fuel prices differ markedly from national averages quoted here, final average figure may be biased up or down. Amount of the bias and slope of the trend line are up to discretion of the evaluating engineer. But any large deviation from a straight eye-averaged trend line must be carefully documented.

For more information on overall fuel costs for power services and partial area breakdown of national averages see POWER's *TD* report, Sept 1958, "Fuels: A look ahead."

heat recovery equipment payout time

Fuel cost estimates for a given plant or area are not easily come by. However, a fair approximation would be obtained by taking average rate of rise for the past 10 or 20 years and projecting to the future 10 or 20 years, depending on the capitalized life of equipment. International Paper Company's Panama City Mill used this approach to determine the economics of a packaged Ljungstrom air preheater, when it decided to rebuild one of its power boilers.

In 1955 plans were made to rebuild the boiler and convert to coal for primary firing. Based on averages, fuel cost for the coming 10 years was projected and one-half the trend line rise was used for preliminary evaluation. This amounted to about 35c per million Btu.

Installation costs for this application were increased by repositioning the equipment. In rebuilding the boiler for coal firing a dust collector was installed. This meant normal boiler outlet had to be repositioned. Drawing, left, shows layout of the boiler, air heater and collector. If the collector was used without the air heater, outlet would have been moved from *A* to *B*. When including air heater, new boiler outlet moved from *A* to *C*. Gas side of packaged air preheater acts as large portion of duct, so very little additional gas ducting was necessary.

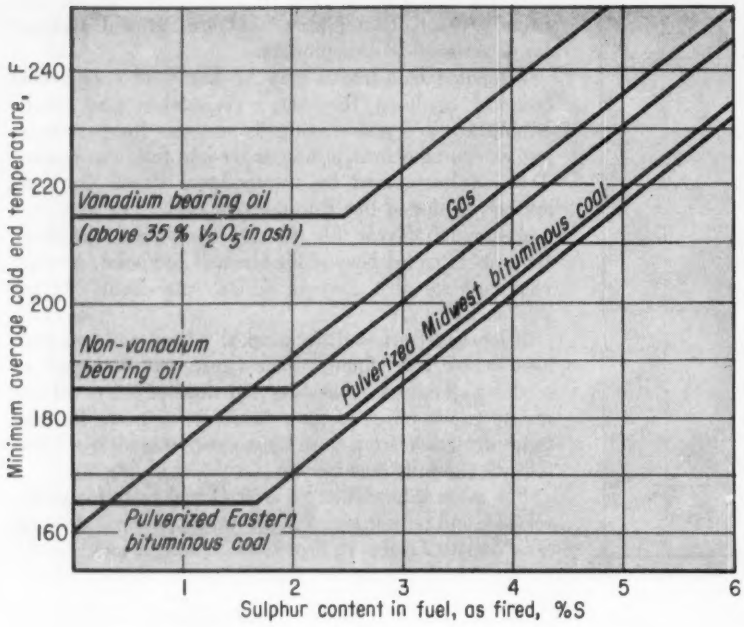
Air duct and forced-draft fan presented a different situation. If air heater was not used, the f-d fan and existing ducts would suffice. By including an air heater, the f-d fan could not be used in its former location, beneath the boiler. Table, next page, shows costs of air heater, f-d fan, and duct work. From the figures, delivered and erected (D&E) cost of air heater plus changes necessary to accommodate air heater amounted to $33,988. Total cost including the dust collector was $48,752.

Erection estimate of 200 manhours for packaged air preheater includes bolting to foundation, wiring, and piping lubricating and cooling-water systems. An extra 400 manhours were necessary to snake the unit past and around existing equipment and into place. This increase in man-hours is generally inherent in rebuilding projects. Original erection estimates cannot possibly account for all obstructions that might increase man-hours. In this case, proximity of another boiler complicated problem.

Load estimates for evaluation were based on past records. Average steam flow was pegged at 85,000 lb per hr for 8000 hr a year. Evaluation concentrated on savings for coal firing since it would be primary fuel.

continued

Fuel characteristics limit flue gas temperatures



Ljungstrom metal temperature control guide, left, was developed from operating experience with fuels of various sulfur contents. It is used to find permissible exit-flue-gas temperatures leaving air preheater, so greatest recovery can be realized without requiring corrosion protection.

As long as flue-gas temperature leaving air preheater is high enough to prevent approach to the dew point, corrosion will be minimized.

Average cold-end temperature is calculated as mean between preheater inlet air temperature and flue-gas exit temperature (without leakage). Correction between exit-gas temperature with and without leakage is based on heat balance assuming all leakage occurs at cold end of air preheater.

Minimum temperature for pulverized anthracite firing is 150 F. For coal firing on stoker, add 20 F to value for pulverized-coal firing

Gross savings are a product of average fuel cost, average annual load and Btu saved. In this case, installing air preheater raised unit efficiency 9.7% and reduced fuel consumption 11.7%. Assuming fuel cost of 35c per million Btu, annual gross savings came to $37,650. This figure was trimmed by fixed charges and increased operating costs. Fixed charges, taken as 12.5% of D&E price, amounted to $4250. Air pressure loss and draft loss of preheater boosted f-d and i-d fan power. This increased unit operating cost by $1704. Subtracting these two items from gross savings produced estimated net savings of $31,596, and a 1.08 year payout time.

In this particular case, the type of fuel did not matter when establishing the payout time or percent return of money invested. For any other application, one of the factors having a bearing on payout time would be the amount of recovery air heater could tolerate with respect to corrosion protection. Each fuel has its own limitation. These limitations are exaggerated by sulfur content of the fuel. Ljungstrom metal temperature guide, shown above, supplies design and operating limits which prevent cold-end metal from running below dew point for the specific fuel fired.

So, fuel savings or increase in boiler efficiency can be affected by the type of fuel fired, as well as sulfur content of the fuel. As long as fuel does not require special corrosion protection, such as steam-coil air heaters, air heaters, air heater bypass etc, then fuel costs based on exit temperature will be the only consideration.

Payout times for other heat-recovery equipment may not be as spectacular. This is only natural since air preheaters are capable of increasing cycle efficiency more than any other single piece of equipment. However, as unit capacity and fuel prices go up, other equipment becomes more economic.

Recognizing importance of fuel costs over the life of equipment, you will be able to compensate for rising prices and calculate a realistic evaluation of payout.

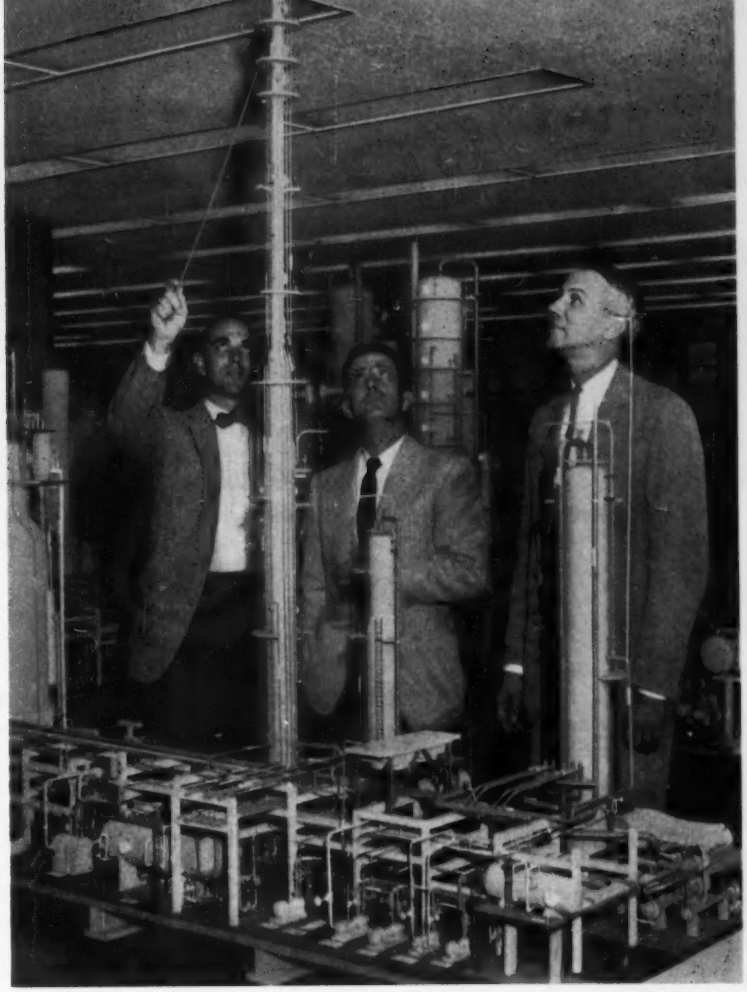
Equipment evaluation

Based on fuel cost of $0.35/$10^6$ Btu from fuel-cost trend
Fuel saved—1010 lb per hr
Hours operated per year—8000
Btu of fuel—13,319
Gross fuel savings—1010 lb per hr × 13,319 Btu per hr × 8000 hr per yr × 0.35/10^6 Btu = $37,650
Fixed charges = 12.5% of D & E price of air heater
D & E price = $33,998.00
Fixed charge = $4249.75
Operating cost = $1704.00 (increased fan hp)
Total operating cost = $6053.75
Net fuel savings = $37,650–$6054 = $31,596
Total cost of air heater—$33,998.00
Net annual fuel savings—$31,596.00
Payout time—1.08 years
Percent return on investment—93%

By J W FOLLANSBEE
Assistant Editor

Scale models often cut construction, maintenance costs. They're best suited for complex plant designs, but only study can show . . .

How scale models pay their way



ENGINEERS REVIEW completed model of petroleum plant section before giving final OK. Once design is accepted, isometrics are drawn and sent to the fabrication crew

Scale models enjoy wide acceptance as a sales, advertising, and public relations aid, but not fully as a design tool. Yet the reason they payoff in these lay areas can hold equally true for design work. Models show complexity in three dimensions, in a form easy to understand. They effectively eliminate visualization problems. Well-made models mean fewer design errors and lower construction and training costs. Despite these facts some engineers resist using models as a design tool. True, they are costly and traditionally take long to build. The first problem may always exist; the second has been partially solved. So, even though model building costs often run into five figures, in many of today's plants this expense for a design model can be fully justified.

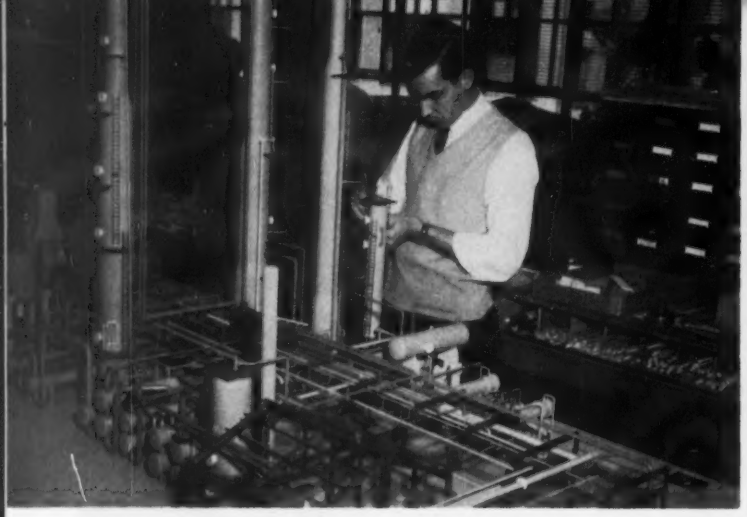
Before probing into model usage, let's establish just what is meant by a design scale model. Look upon it as a miniature plant—piping, equipment, structures—built accurately to scale. The model has no moving parts and doesn't work in the normal sense. Piping layout in process plants, and equipment location in manufacturing plants, are typical areas where models may be used effectively.

Main benefit from the use of models is ease in communication. This works two ways: first, as the designer prepares a piping layout he can quickly see solutions to many design problems on the model; second, other men concerned with the plant can spot problems the design might create in their departments.

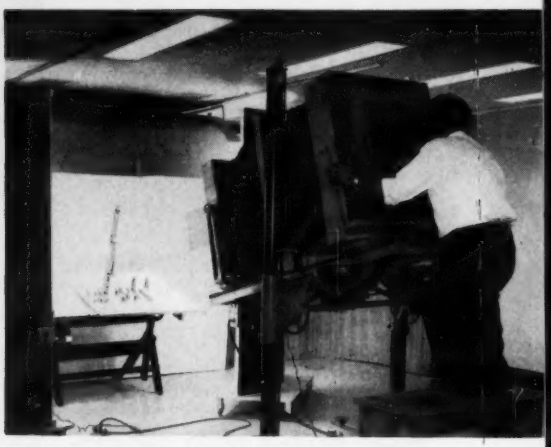
Although a designer is often the only one who works directly with the model, construction, operation, and maintenance people are called in to review it during different stages of design. Here they see what problems exist and determine best how to solve them. Solutions are suggested during the review, changes are made and approved; after each review the designer knows his design is optimum.

Plant management, either your own or a customer's, also benefits from models. The designer can easily get across to management what they're buying without using prints.

To obtain these benefits, pay close attention to detail during model assembly. Initial decisions about purpose, type, and mechanics of building the model will determine its success. Why do you want the model? Should



MAJOR EQUIPMENT is located from plot plan. Designer then determines best pipe runs on model. Stocking scale parts nearby speeds model assembly



PHOTOS of completed model (isometric and plan views) eliminate need for complete piping plans

"Make them accurate . . . make them easy to assemble"

it be block or in complete detail? Who should build it and where? What are the best materials?

Speed is key to model success. Anything that stretches model-building time works toward defeating the model's purpose. Most benefit from working with models comes in being able to fix final design before construction starts. If the model assembly time drags and model is completed after building starts, much of the value is lost. Model materials—plastic, wood, extruded metal—aren't vitally important if parts can be put together and taken apart quickly.

How much detail? This depends on the model's purpose. There must be enough detail to give the full design story immediately. Too few details might result in failure to tell the men concerned what they need to know. Don't simplify to the extent that it hinders the model's purpose.

Speed and cost are linked to the model builder and where it is built. There are three common ways to tackle model building: first, let a modelmaking firm build the model in their shop; second, have a designer-modelmaker team work together in your drafting room; third, let your designer build the model in the drafting room.

First method has been standard for years. It once was a slow way to design for lack of technique: It is now generally competitive. The outside model builder serves well those who use models infrequently or have offbeat designs. Normally, the modelmaker works up his handiwork from design drawings. Time lost here need not be excessive but close control is a must to get model completed on time. Make sure the modelmaker has a clear understanding of your drafting techniques and symbols before he starts work.

Second method, the designer-modelmaker team, has the advantage of work being done near the designer's board. Here the modelmaker can work with both prints and verbal instruction. Also, designer can see the job grow before him and make changes when necessary.

Third method eliminates the outside modelmaker entirely. Here, the designer makes his own model. By using recently developed model-making techniques the designer often can do a top job unassisted. He starts by locating major equipment on the model base from a plot plan. Next step is to create piping runs right on the model. He can design as he goes along. This technique offers speed in assembly and ease in making changes. The drawback: finding an assembly system that is simple enough for a designer to handle.

At least two companies—The M W Kellogg Co on the East coast and the Fluor Corp Ltd on the West coast—follow a plan similar to this. Both worked out model building methods to fit their design practices and found it pays when designing complex layouts.

Regardless of the technique, once the final design is approved and model dimensions are identified, drawings can be made, and photographs taken of model in plan and isometric views. This eliminates the need for extensive piping plans.

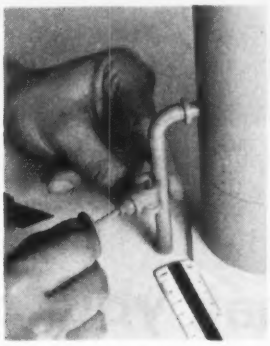
Pipe centers and main equipment dimensions are included on model. When used in full scale these dimensions will be accurate to within about one inch. Drawings take care of the finer dimensions. Since approximate measurements and all equipment relationships can be spotted just by looking at the model, the final job of full-scale plant construction is simplified when erection crew takes over.

Total savings in using models does not show up in the design stage. Design costs for piping layouts run about the same with models as with normal drafting. The real savings show up in lower costs during construction, operation, maintenance, and when future changes crop up. However, the model can pay for itself in the design room by cutting total design time. This saving offsets the cost of model materials and design changes, so other benefits can

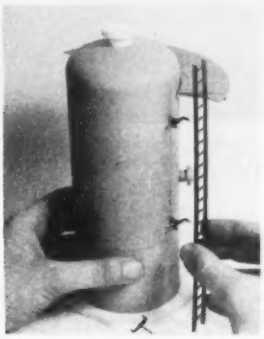
Plastic parts are easy to work

1 First, cut stock-size foamed styrene tank to right height

2 Locate nozzle from prints, attach elbow, then scale pipe



3 Color-coded pipe, elbow are push-fit; the valves snap on



4 Design fasteners for fast part repositioning during reviews

be considered money in the bank.

Further benefits come by using a design model as a training aid. Many firms use models of new plants to help in orienting and training crews during plant construction. Cost of a basic training model runs about half that of a design model. But a design model which will do double duty in also acting as a training aid during construction is a cost saving item.

Modelmaking firms now have do-it-yourself kits that give you most of the basic items you'll need for piping and plant layout design. Thus, your men can experiment to some degree to find which of the three methods is most suitable.

Pitfalls. Although it may be best to erect the model in your own drafting room, presence of the model can lead to some time and money wasting actions. It's easy to get carried away and try for absolute realism in a model. Treat the model as a design tool, nothing else. Unneeded items such as lighting fixtures, handrails, conduits and the like add much to the model's cost but little to its usefulness. For a display model extra detail is fine, but it is not suitable for design.

Fight trivial changes in design. Since you can spot minor dislikes about as quickly as major faults, you may want to make small and really unnecessary changes. These minor rearrangements can total up costwise.

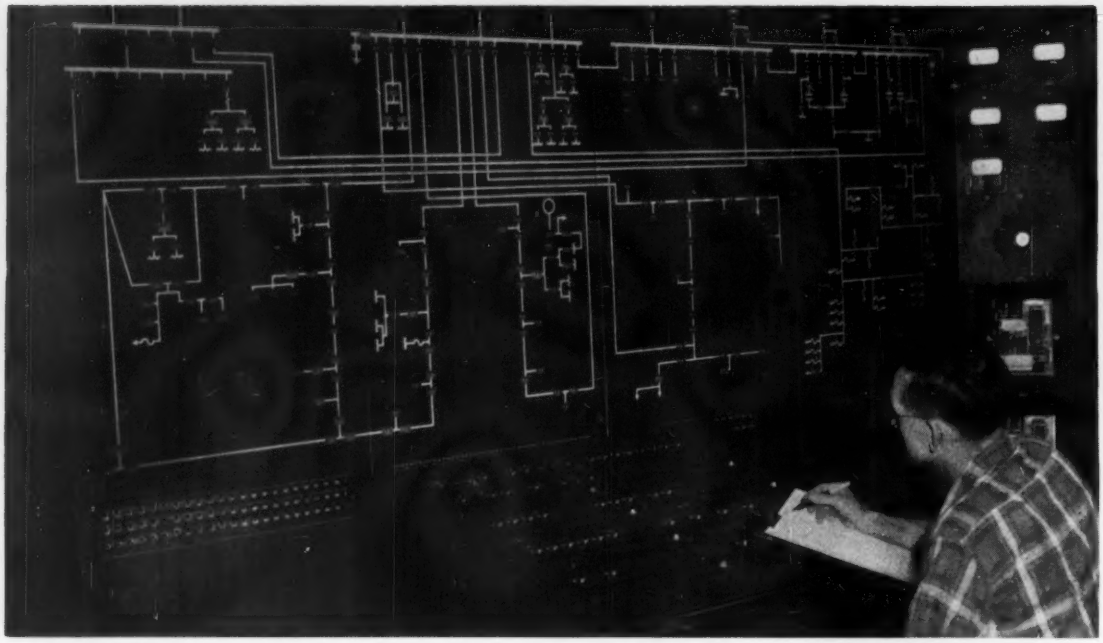
Keep model up to date when it goes in the field. Duplicate on the model any construction changes in the plant. This will help keep the construction worker's confidence in the model's accuracy. The model is just as new to the construction crew as it was to the design group, and it must prove its worth to the field men as it did to the designer. If the field men lose confidence in the model's worth because of minor discrepancies, they'll refuse to use it and you will lose a major advantage in model application.

Finally, get a written report from all involved with the model on their opinion of its success. Get suggested changes soon after job is finished. They'll help you obtain greater value from models on the next job.

Models aid $21 million modernization

A miniature plant with more than a thousand scale models serves as a plan board for the Westinghouse Steam Div in modernizing the Lester, Pa. facilities to meet a peak demand for electric power in the 1962-64 period. It will also put the company in a better position to meet rising domestic and foreign competition.

Built to a scale of ¼-in. to a foot, the model layout of machine and turbine components represents nearly a million and a half sq. ft. of actual production space.



MASTER STATION, ***above,*** **controls electric power distribution throughout large industrial plant. Illuminated line diagram in background automatically indicates status of all parts of system. Meters at right supply system supervisors with basic operating data**

To keep you informed on an expanding control field, Part 1 of a series shows . . .

What you can

What is supervisory control?

What do these systems do? How do they operate? To bring you a complete story of supervisory systems for the power services we begin this month Part 1 of a series. We will cover basic system functions, from coding methods to transmission types. In this and following articles we split basic operation into two different categories:

Pulse coded systems

Frequency coded systems

Pulse coded systems are described by an expert with long practical experience in applications to industrial power services. Frequency coded systems and following articles on special use of supervisory control are by other experts in these fields.

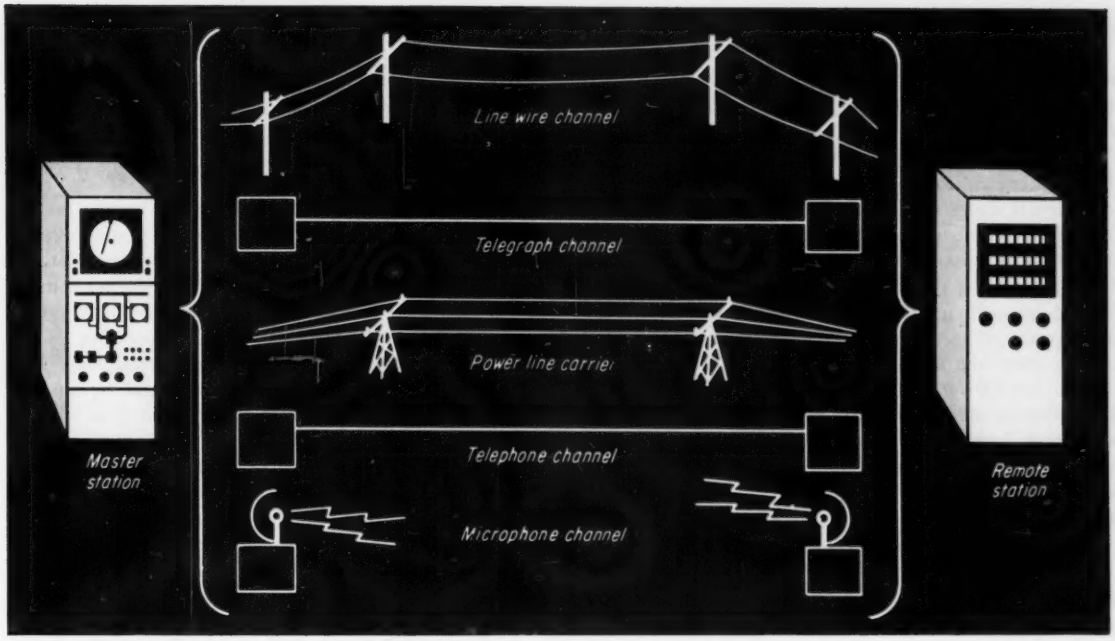
Use of supervisory equipment for remote control functions has accelerated rapidly. For over 35 years supervisory systems have been used largely to control unattended electric utility and city transit power substations. However, supervisory equipment may be used to control any apparatus which can be electrically operated.

In recent years, supervisory systems have been widely used for remote operation of pumping stations on petroleum pipelines, valves and pumps on water supply systems and remote control in plants for scattered power-service equipment.

As more and more supervisory equipment shows up in power-service systems you will need to know how and where you can best apply it. This article supplies basic information you must have to help you select the proper system for your power-service needs.

Basically, a supervisory system is a set of equipment at remote station and at master station. The sets interconnect by communication channel such as telephone line or power line carrier circuit. Equipment remotely controls and continuously indicates operating conditions at unattended installation. Practical distance between remote and master stations is unlimited if equipment is applied properly; on some installations distance is over 1000 miles.

Supervisory systems may be used over distances of a few hundred feet in some cases. It is usually more



CHANNEL SELECTION depends on basic supervisory equipment application and availability of channels. Master station sends control impulses, interrogation signals to remote station. Same channel transmits operating information back to the master station

By W F CRUESS, Westinghouse Electric Corporation

do with modern supervisory systems

economical to use multiconductor control cable for short-distance control. However, if control lines cross a river or city street, it may be most economical to use telephone circuits. Supervisory systems may also be used profitably where controls for a large number of devices must be concentrated, such as a control desk. Since switches and indicating lamps used on supervisory systems are small, many controls can be mounted compactly.

Supervisory equipment is essentially apparatus which performs a large number of operations over a common communications channel. Although it performs operations singly, this "one operation at a time" characteristic is usually not a limitation; the equipment requires only a few seconds per operation. Each operation to be performed is assigned an individual code signal, and is called "point," "function" or "position" of supervisory system.

Particular type of supervisory equipment used is determined by:

(a) Type of communication channel used, (line wires, power line carrier, microwave, etc)
(b) Number of points handled
(c) Types of points to be used (indication points, control points, telemetering points or combinations of these)

Terminology. Supervisory field was handicapped by a lack of standard terminology. Confusion occasionally rose because manufacturers and users employed different terminology. American Standards Association solved this in their latest revision of "Automatic Station Control, Supervisory, and Associated Telemetering Equipments." Several definitions of terms from this publication are included at the end of this article.

Supervisory systems function by transmitting coded signals over channel linking master station and remote station. Signals are invariably groups or combinations of pulses or different audio frequency tones. This article describes pulse coded signals.

Systems using pulse coding require only a telegraphic-type channel which can handle simple "on-off" pulses, at about 15 pulses per second.

Line wire circuit is the most widely used channel for supervisory systems. It is usually a pair of telephone type wires. Signals are sent by pulses of direct current (about 5 to 20 milliamperes) from one station to the other. Separations of 100 miles are feasible if heavy conductors and sensitive relays are used.

Telegraph circuit is commonly used for teletypewriters. There are several variations, known as half-duplex, full-duplex, 60-milliampere loop, etc. It is usually the least expensive channel available, with a monthly rental only a fraction of that for a pair of line wires. Telegraph circuits handle only on-off pulses, such as signals of pulse type supervisory system. They cannot handle audio frequencies and so cannot possibly be used as the connect-

ing channel for a frequency coded supervisory system.

Audio tone channel uses an audio tone transmitter and receiver with supervisory equipment at each station. Supervisory equipment sends pulses by turning the audio transmitter on and off. (This is not to be confused with a frequency type supervisory system.) Resulting pulses of the audio-frequency tone can be sent over any channel you can talk over. These signals can modulate the power line carrier or microwave equipment. Or when applied to a line wire circuit, they multiplex several supervisory channels on one pair of wires. Since tone pulses can be handled by ordinary telephone company repeaters, they can be transmitted extremely long distances, like a long-distance telephone call.

Power line carrier. If the carrier voice channel is available it can be modulated by pulses of audio tone. However, most common method simply sends supervisory pulses by keying carrier on and off. Same carrier channel can be used jointly by supervisory equipment and protective relays.

Telephone line carrier. Telegraphic carrier can be simply keyed on and off—like the power line carrier or audio tone channels described above. Voice type carrier can be modulated by the audio tone pulses, also described above.

Microwave. Usually audio tone pulses are used to modulate one of the voice channels provided by microwave equipment. If microwave multiplexing provides telegraphic channels, supervisory pulses can be sent by simply keying this channel on and off.

Several types of functions or points are commonly used, and are available on commercial supervisory systems, often in combination with control.

Two-condition supervision indicates the position of a device which can be in either of two positions, such as a circuit breaker, motor contactor, alarm contact, etc. Open-or-closed contact arrangement operates indicating lamps at the control station to continuously show the status of the remote device. It can operate an alarm, if desired, when status of the remote device changes.

Three-condition supervision shows the status of a device having three possible conditions. It usually indicates positions of valves, gates, regulators, etc. Supervisory indicating lamps at the master station show whether the remote device is at one or the other extreme position, or at neither.

Control and supervision can operate a remote device to either of two positions, and indicate and monitor the position of the device. It is most commonly used to control circuit breakers. It is seeing increasing use for remote control of shutoff valves and dampers.

Control and telemetering positions an adjustable device, such as a tap changer, a control valve or a gate, and telemeters the position of the device or resulting change in some variable. Supervisory system remotely controls device by directly actuating positioner, or adjusts the set point of the closed loop control at the remote station.

Selective telemetering returns a telemetered reading from a remote station over the same channel used by the supervisory system. Supervisory equipment can (1) select one of a number of telemeter transmitters in the remote station (2) switch its input to the desired quantity and (3) report back to the master station.

Sequential reporting of data from remote stations need not interfere with emergency information. Remote stations can be designed to automatically switch inputs and report special data to master station in case of equipment failure, safety trips, etc.

Supervisory equipment using a voice channel makes possible remote supervision of a station when there is no continuous, exclusive channel to the remote station. Equipment connects to a conventional telephone in a remote station. Attendant at the remote station can answer telephone calls and carry on a conversation. However, when the station is unattended, the equipment will automatically lift the telephone receiver and report station conditions by coded bell strokes and tone pulses.

Complex systems, including control and telemetering of all functions, begin to resemble large digital controllers and data loggers. These supervisory systems usually include all the various types of functions as part of the integrated master system.

Operation of several remote stations from a centrally located master station may use separate channels for each remote station, common connection of remote station to channel or a combination of both. Connecting several remote stations in a common chain through one channel obviously saves cost for the channel but often results in reduced system flexibility and shorter possible transmission distance. Also, channel failure can cripple entire supervisory system. Single channel use is most popular where remote stations run in a single line away from the master station. One example of this condition is control of pipeline pumping stations.

American Standards Association adopted basic terminology

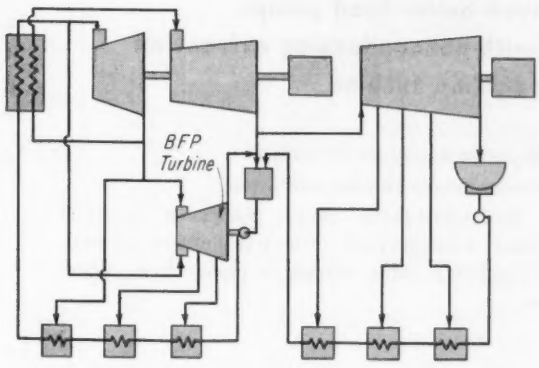
System terminology used in this article follows definitions adopted by the American Standards Association and published in their report titled "Automatic Station Control, Supervisory and Associated Telemetering Equipments." Several basic terms are defined as follows:

Supervisory system—New general term for this apparatus. (According to the new standard, "supervisory control" is a type of supervisory system which provides remote control only; without indications or telemetering selection.)

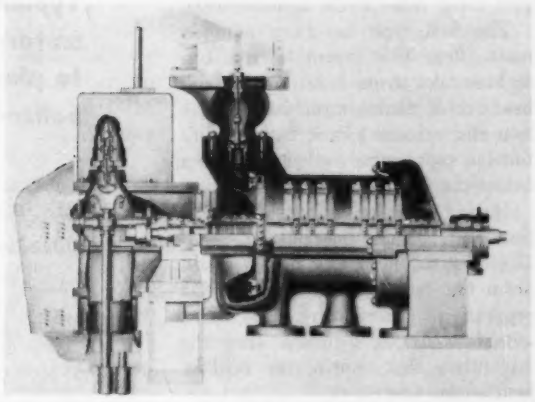
Remote station—Unattended station operated by the supervisory system. This supersedes "substation," "controlled station" and "outlying station."

Master station—Accepted term which supersedes "dispatching office" and "controlling station."

Interconnecting channel—Channel connecting master and remote stations. This may be a line wire carrier or microwave.



1 Boiler-feed-pump turbine drives become integral part of central-station regenerative-cycle heat balance when properly used



2 Seven-stage m-d turbine for central-station boiler-feed-pump drive has two extraction points and exhausts noncondensing

Having reviewed how m-d turbines run, are built, controlled and lubricated we're now ready to learn how they may be used. Here we learn the advantages of . . .

Turbine-driven boiler-feed pumps

By E L PACE, Advance Design Engineer, Small Steam Turbine Dept, General Electric Company

After some 20 years of using motor drives for boiler-feed pumps in central stations almost exclusively, we now have several large stations using turbine drives, with more in prospect. This revives the practice in our early plants and that used for superposed turbine plants in the 1930's.

Several reasons contribute to adopting the turbine drive. Rising main-turbine ratings and steam pressures need larger electric auxiliary power systems — these become expensive. Rising boiler-feed-pump (bfp) power finds advantages in turbine drive compared to motor drive when evaluating the costs of the entire plant. Turbines act as direct-connected variable-speed drives for high-speed pumps, 5000 to 7000 rpm, that have lower costs and shorter shaft spans. The widely accepted reheat cycle offers gains in net cycle efficiency when using a noncondensing extraction turbine to drive auxiliaries; this lets low-temperature non-reheated steam do a part of the feedwater heating.

Economic advantages. Because the bfp turbine drive does not subtract power from the main generator gross output, it helps reduce the investment per net kw for the plant.

Improved cycle efficiency of 0.1 to 0.3% reduces the net fuel cost accordingly. The bfp turbine saves on overall station space and simplifies piping in the congested space under the reheat turbine of the main unit. The noncondensing extraction bfp turbine supplies some of the feed heating steam. This arrangement uses lower-temperature heaters.

Operating advantages. Direct-connected bfp turbines give variable-speed drive without coupling-slip or feedwater-throttling losses. They give easier control and fast response in feedwater flow changes. Eliminating the motor drive reduces the problem of transferring auxiliaries to another bus in emergencies. This also reduces the electrical power needed to start the station from cold. The bfp turbine warms the main steam line before starting the main turbine. Proper cycle design has good effect on deaerator pressure and pump net positive suction head (npsh).

Plant design. Plant cycles with either type of pump drive should be designed as integral units; not by using one type of drive for cycle design and then simply changing the pump drive. With this approach we find turbine-drive advantages compared to motor drive, and certain design differences, see table, p 72.

Cycle layout. There are several possible sources and sinks for the bfp-turbine steam. Arrangements most often attractive use (1) noncondensing extraction bfp turbine, Fig. 2, or (2) straight-condensing bfp turbine. Special circumstances may sug-

gest using other cycle arrangements.

The first type has been adopted most often. This layout has the bfp turbine take steam from the cold reheat line of the main turbine. Extraction and exhaust steam from the bfp turbine supply the feedwater heaters below the cold-reheat heater, Fig. 1.

During starting, light-load operation and certain emergencies, separate first-stage nozzles admit steam from the boiler under control of a separate governing valve. This opens automatically in sequence after the 1-p valves that control the cold-reheat steam admission.

This layout improves station net heat rate about 8 to 25 Btu per kwhr because steam, at a lower temperature than could be bled from the reheat turbine at the same pressure, does part of the feedwater heating.

With constant pressure at the main-turbine inlet, the pump total head drops as load drops because of diminishing system friction head. The pump efficiency, however, drops more rapidly than the total head below 65-75% of rated kw. This makes the work input per lb of water rise as load drops below this point.

Pressure ratio of the bfp turbine from inlet to exhaust (and so the available energy per lb of steam) stays nearly constant at all loads. Since bfp-turbine steam flow capacity is proportional to the cold-reheat pressure, which is nearly proportional to the main turbine throttle flow, its work output per lb of water is about constant over the load range. To run over a reasonable load range on cold reheat steam, greater flow capacity must be provided than needed at rated kw to compensate for reduced pump efficiency at part loads.

At some reduced load (about 50-60% of max load on the main turbine) the valves admitting cold-reheat steam open wide; at lighter loads steam directly from the boiler will be admitted. The boiler steam has a larger available energy per lb and makes it possible for the turbine to drive the pump in the region of lower pump efficiency.

Exhaust steam disposal from the bfp turbine can be arranged in three different ways:

a. Floating exhaust heater has no other steam source than the bfp-turbine exhaust, so its pressure depends on the heat input from the exhaust steam and the heat absorbed by the entering feedwater. The exhaust steam flow depends largely on the power needed to drive the pump. At light loads the bfp turbine uses boiler steam to supplement cold-reheat steam to maintain necessary output. The load range using only cold-reheat steam can be extended to lower loads by a feedwater bypass around the heater below the exhaust heater. This lowers the feedwater enthalpy entering the exhaust heater and so the heater pressure.

b. Return to crossover. When the bfp-turbine-exhaust heater connects to the main turbine crossover, steam may flow to or from the crossover depending on whether the exhaust flow matches the heater steam demand. Ratio of exhaust flow to heater demand, in general, is larger at maximum load and at light load than at rated load. Valves in the line to crossover allow flow in either direction but close automatically to prevent exhaust steam entering the crossover on main turbine overspeed from loss of load or turbine tripout. Fig. 3 shows the bfp turbine steam flows for a typical application.

c. Extraction to exhaust heater. This arrangement connects the bfp-turbine-exhaust heater to an extraction point on the main turbine. Usually this point will not be at the crossover; exhaust steam should not be admitted to the main turbine since it is at a lower temperature than the steam at the extraction pressure in the reheat turbine.

In contrast to adequate mixing at the crossover, admission at the extraction opening might allow stratification that could cause thermal distortion. A nonreturn valve in the extraction line allows steam to be extracted from the main turbine to satisfy the heater, but prevents excess exhaust from entering the main turbine.

This layout runs like *b* when extracting steam from the main turbine, and like *a* when the nonreturn valve closes and heater pressure rises above the shell pressure at the extraction opening.

To allow the bfp turbine to run over a wide load range on cold-reheat steam only, 20 to 40% of the exhaust-heater steam demand must be extracted from the main turbine at rated load, by choosing proper heater pressures. At 50-60% main turbine load the extraction drops to zero and the nonreturn valve closes.

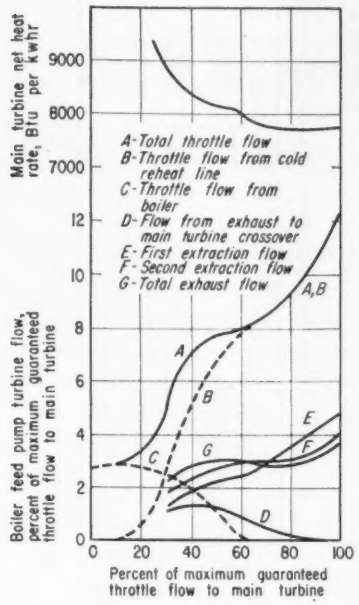
Typical percent changes from a plant with motor-driven boiler-feed pumps to plant with noncondensing extraction boiler-feed-pump turbine

Constant main generator gross kw output

Adding: Boiler-feed-pump turbine and piping

Eliminating: Boiler-feed-pump motor, associated electrical equipment, variable-speed ratio transmission or feedwater regulating valve, extraction piping from reheat turbine

Main turbine inlet steam pressure, psig	1800	2400	3500
Flow to boiler	+3.2	+4.2	+7.0
Flow to reheater	–6.8	–8.3	–11.7
Flow to condenser	+1.5	+2.1	+3.3
Net kw output	+1.6	+2.3	+3.5
Main transformer rating	+1.6	+2.3	+3.5
Capacity of auxiliary electric power system	–23	–29	–38



3 Bfp-turbine steam flows do not vary in proportion to main-turbine steam flow

At still lighter loads, the exhaust-heater pressure rises and the bfp turbine uses h-p steam from the boiler.

At light loads, *a*, *b* and *c* use h-p steam since pump power drops less rapidly than the cold-reheat pressure. All need a connection from exhaust to condenser that can be opened for starting and emergency.

Deaerator connected to the bfp-turbine exhaust for *a* or *c* will have a higher pressure than one connected only to main turbine. This keeps deaerator pressure above atmosphere at all loads giving better npsh on the pump on sudden load loss.

Tieing the deaerator to an extraction point on the bfp turbine gives similar benefits, but the pressure may become rather high under certain emergencies. If excessive, the pressure could be relieved by passing some of the extraction steam to a lower pressure heater.

Feedwater enthalpy rise. Turbine work needed per lb water establishes the pressure ratio for the bfp turbine and the enthalpy rise in the feedwater produced by the turbine steam. About equal enthalpy rise in all heaters develops the best heat rate. In practice, the cold-reheat heater should have somewhat greater than average rise at rated load to obtain optimum performance over the entire load range. This extends the range over which the bfp turbine runs on cold-reheat steam only.

Pump speed. For 150- to 250-mw main units the volume flow through a full-capacity noncondensing extraction bfp turbine gives best efficiency at pump speeds of 6000 to 7000 rpm. Larger main units favor somewhat lower speeds. With half-capacity pumps the main turbine ratings corresponding to a given pump speed would be doubled.

Pump capacity. With noncondensing extraction turbine drive, a single full-capacity pump has lowest investment cost and best cycle efficiency. Two full-capacity pumps give same efficiency with maximum protection but increase the investment. Two half-capacity pumps drop cycle efficiency 0.05 to 0.1% and give part capacity on a one-pump loss, but are intermediate in investment to the above two layouts. Lower investment, better efficiency and high turbine reliability have often favored choosing a single full-capacity pump.

Evaporator. When an evaporator takes its driving steam from the main turbine, the evaporated makeup and driving-steam condensate should go to a heater not connected to the bfp turbine. The full steam-absorbing capacity of those heaters will be needed by the bfp turbine.

For driving steam extracted from the bfp turbine, the evaporated make-up and condensate can return to a heater connected to the bfp turbine with minor effect. Performance at light load should be checked. A separate evaporator condenser makes the evaporator have a negligible effect on the bfp turbine.

Normal operation. Variable air-pressure signals from a 3-element feedwater control regulate the bfp turbine. Through an air motor the signal moves the pilot-valve bushing of the turbine-speed governor to change the turbine speed as needed.

The turbine valve gear, under control of the speed governor, moves to the correct position to carry the pump load. Depending on degree of automation wanted, controls can be arranged to need little or no operator attention except to start the station or handle unusual cycle conditions.

Maximum water flow. The turbine must drive the pump when it delivers maximum water flow at required discharge pressure with the available steam conditions on the main turbine. Maximum water flow may provide for pump wear, makeup and some excess capacity above maximum steam flow to allow raising a low boiler-drum water level.

Excessive margin in capacity may adversely affect performance under normal operating conditions. Margins should be held to those giving best all-around performance and capacity for the plant.

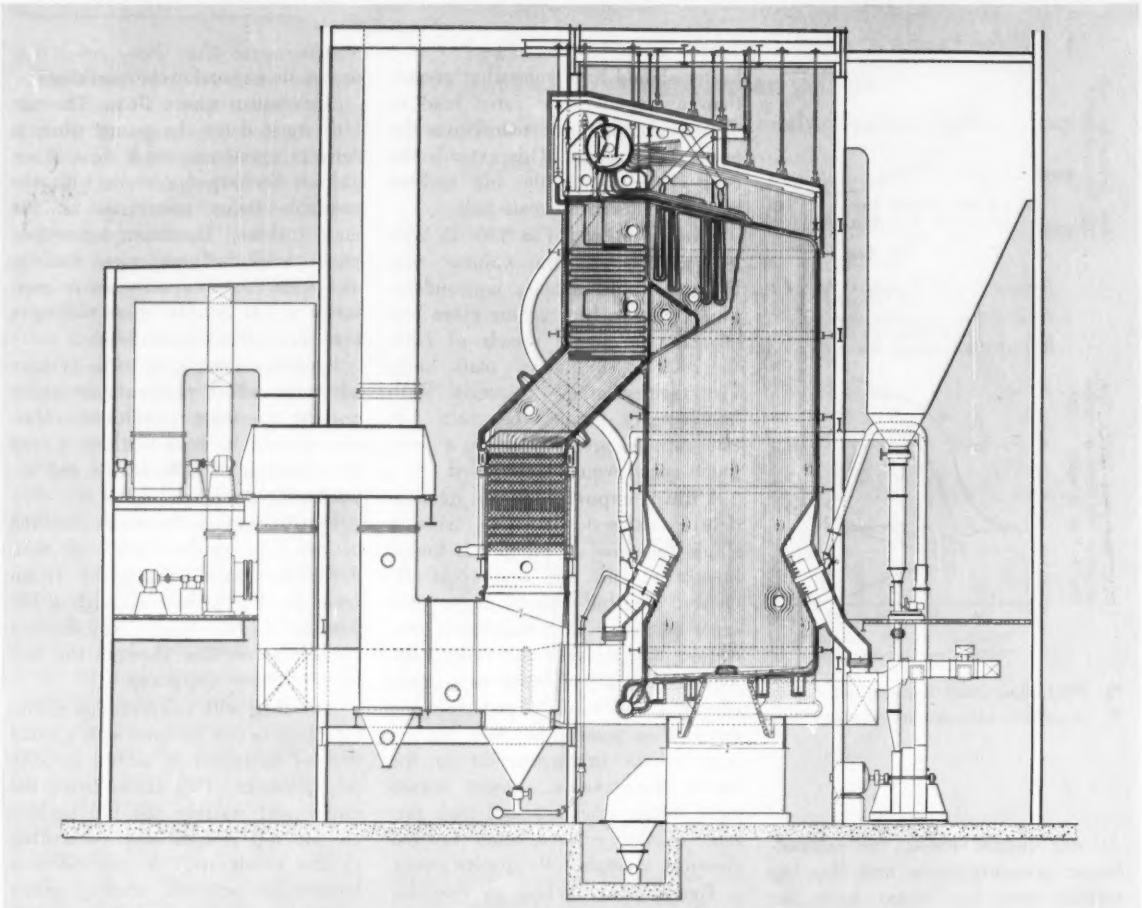
Out-of-service heaters connected to the bfp turbine need not shut down the plant. Extracting steam from the bfp turbine through a bypass to a lower heater can develop enough steam flow through the turbine to drive the pump.

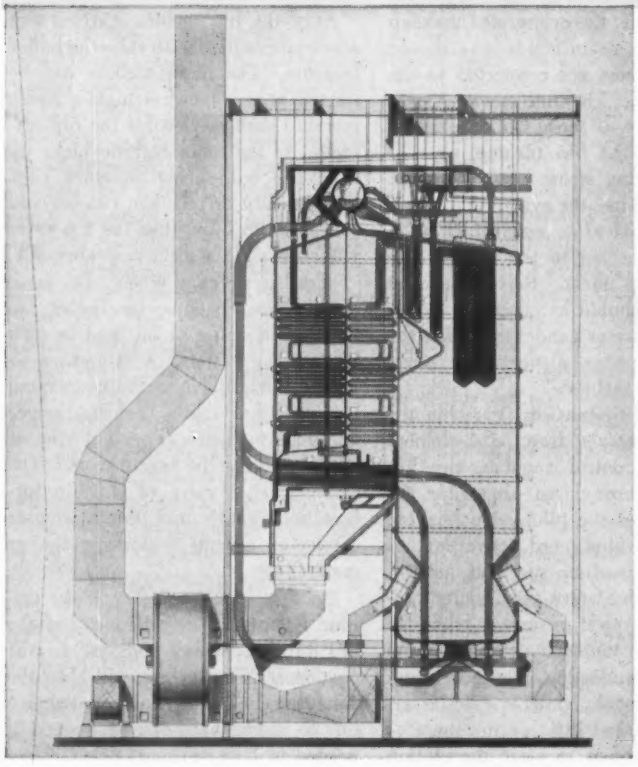
Starting with conventional drum-type boilers can be done with a small flow of feedwater at as low as 200-psig pressure. This allows firing the boiler and starting the bfp turbine on the h-p nozzles and exhausting to the condenser. A motor-driven booster or separate starting pump would furnish the water initially.

After the bfp turbine starts it can accelerate as needed to raise the boiler pressure. The main turbine can be started at a somewhat higher boiler pressure than needed for the bfp turbine. As the main turbine picks up load, the cold-reheat pressure rises until the bfp turbine can run on cold reheat steam only, then the h-p valve will close and the cycle runs normally.

Emergencies. When the main circuit breaker trips, the boiler can be kept steaming at no load to pick up load on restart. A nonreturn or isolating trip valve in the connection between bfp - turbine - exhaust heater and main turbine will prevent exhaust steam entering the main turbine. The exhaust relief valve of the bfp turbine may blow until the condenser connection opens automatically or manually.

On loss of vacuum the main turbine throttle valves will trip but the bfp turbine cannot exhaust to the condenser. The turbine will blow the exhaust relief valve until an exhaust line to atmosphere can be opened if needed to lower exhaust pressure.





A Progressive Chemical Company
One 400,000 lbs/hr Turbo Furnace Boiler: 830 F — 1250 psig. Unit is fired by pulverized coal from three Riley Pulverizers. A second Turbo Furnace Boiler of 600,000 lbs/hr has been purchased for a second plant at this location.

A Louisiana Public Utility
One 1,550,000 lbs/hr Turbo Furnace Boiler; 1005 F superheat, reheat — 2175 psig. This unit has a furnace 55 feet wide with no water cooled platens or dividing walls. Fired by natural gas. Can be converted to coal quickly and at low cost.

A Prominent Manufacturer of Electrical and Electronic Equipment
One 150,000 lbs/hr Boiler: 835 F — 900 psig; Fired by pulverized coal. One Duplex Riley Pulverizer.

For the full operating facts of Riley Turbo Furnace Boilers consult your Riley representative.

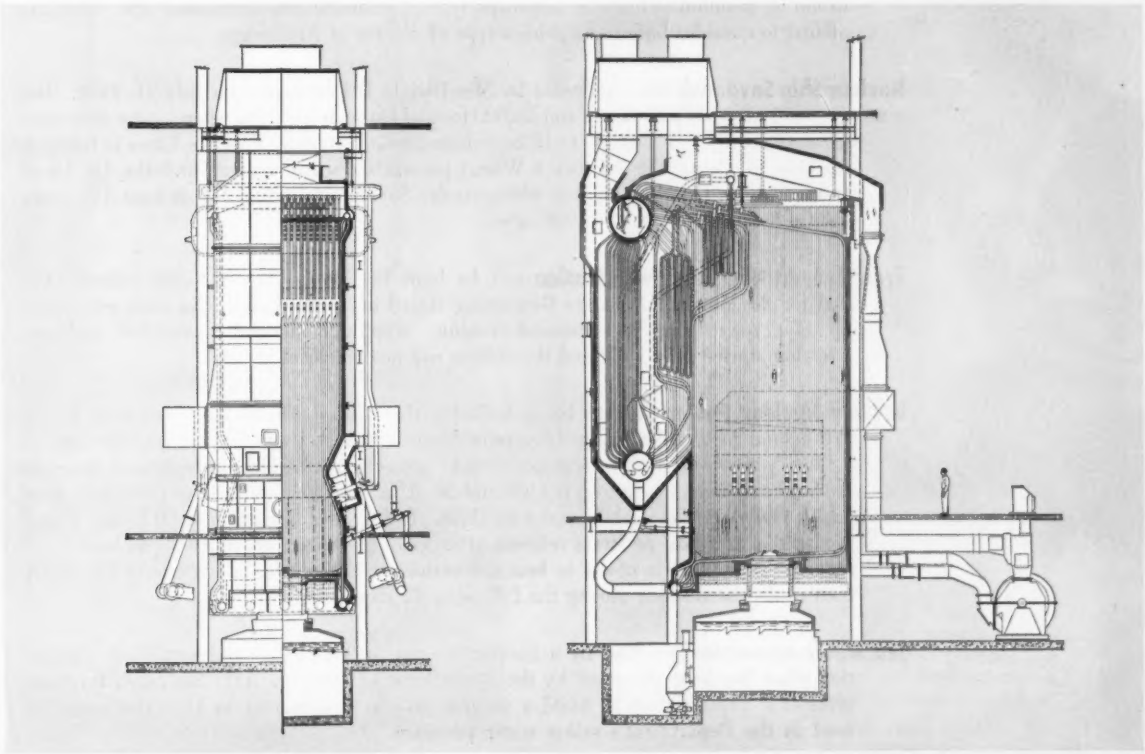
These Three Companies Selected The
RILEY TURBO FURNACE
Because Of These Outstanding Performance Characteristics

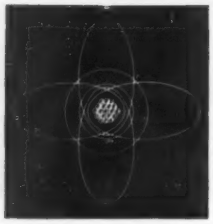
- Eliminates the flyash disposal problem
- Clean furnace walls eliminate necessity of wall deslagging equipment
- High operating efficiency — minimum carbon loss — low excess air
- Uniform distribution of furnace gases across full width of the superheater with minimum variation in metal skin temperatures from side to side
- Maximum utilization of waterwall surface
- Economical and quick conversion from gas and oil firing to coal
- Because of performance characteristics, the Riley Turbo Furnace can be operated at higher heat releases: The size of the unit is reduced thus reducing building costs and permitting higher capacity within a given space
- A wide furnace is possible without need for dividing walls
- One level firing reduces expense for walkway systems
- Provides ease of observation and operation

FOR TURBO FURNACE DETAILS — WRITE RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT





Nuclear notes

By B G A SKROTZKI, Associate Editor

Two nuclear superheat contracts, totaling about $4.3 million, were awarded by AEC. One with Combustion Engineering—General Nuclear Engineering Corporation deals with integral boiling superheated reactors. This work will also apply to a subcontract these firms have for a reactor with the Puerto Rico Water Resources Authority. The second contract with General Electric Company relates to separate superheaters, but will also be of value in developing integral superheaters. Other superheating projects include: development of fuel materials, steam separation and heat transfer at the Argonne Laboratory of AEC; building of BORAX-5 at NRTS, Idaho, and research and development for a nuclear superheater for the boiling-water nuclear plant for Northern States Power Co, Minnesota.

Containment-shell elimination may be in sight if tests being made by Sargent & Lundy at Hennepin, Ill., prove out. Engineers feel that mixing h-p boiling water released by an accident with cold water would prevent pressure buildup and spreading radioactivity. Tests use 23-ft long, 3¼-ft dia drum with rupture diaphragms holding boiling water at 600 psig to simulate reactor. Drum stands in a buried vessel 32-ft high and 14-ft dia filled with cold water to varying levels.

Sodium heavy-water reactor research and development has been shelved by AEC. Work was started in April 1957 by Nuclear Development Corporation of America for a proposed sodium-cooled heavy-water-moderated reactor for the Chugach Electric Association of Anchorage, Alaska. The plant was to develop ten mwe. AEC decided that it would be unsound to build an unproven type at a remote noncommission site. AEC has offered to consider building a proven type of reactor at Anchorage.

Nuclear Ship Savannah was christened by Mrs Dwight D Eisenhower on July 21, 1959. The ship will carry 60 passengers and 10,000 tons of cargo at 21 knots when it goes into service next year. Over $400,000 will have been invested by States Marine Lines in training the crew to operate the Babcock & Wilcox pressurized-water reactor and the De Laval steam turbine. One fuel loading will keep the Savannah running for at least 3½ years over a distance of about 370,000 miles.

Trawsfynydd Nuclear Power Station will be built by Atomic Power Constructions Limited for the Central Electricity Generating Board in North Wales. The plant will develop 500 mwe from two natural-uranium graphite-moderated gas-cooled reactors. Erection started July 1959 and the station will be completed in 1964.

Berkely Nuclear Power Station being built for the Central Electricity Generating Board in England by the AEI-John Thompson Nuclear Energy Company has had the first of its two gas-cooled reactor pressure vessels pressure tested. This is the largest vessel in the world so tested, being 80 ft high and 50 ft in diameter. It weighs 1000 long tons and is made of mild steel, 3- and 4-in. thick. Testing was carried out at 211 psig. Vessel is also the largest to be stress relieved after welding. For stress relieving, radiant heaters used 2-mw electric power to heat the vessel to 650 C over a 2-day period. The vessel then cooled to ambient during the following 14 days.

Sea water conversion powered by a nuclear reactor in a 1-million-gpd multiflash distillation plant has been proposed by the Department of Interior. AEC has asked for Congressional authorization to build a 40-mwt process heat reactor in 1960 that could be used in the Department's saline water program.

circle 233 on Reader Service card, p 97 ➤

Decision made 21 years ago proved to be the right one

Garnett, Kansas Light Plant in 1938, selected Standard Oil diesel lubricant

Situation: In 1938, when Garnett, Kansas put two diesel engines (one 600 hp and one 1000 hp) into service, plant management selected a Standard Oil diesel lubricant. In 1948, when a 1400 hp engine was added, the performance from the Standard lubricant caused management to make the same choice. In 1955, when a 2100 hp duel fuel unit was placed in service, STANODIESEL Oil M was chosen.

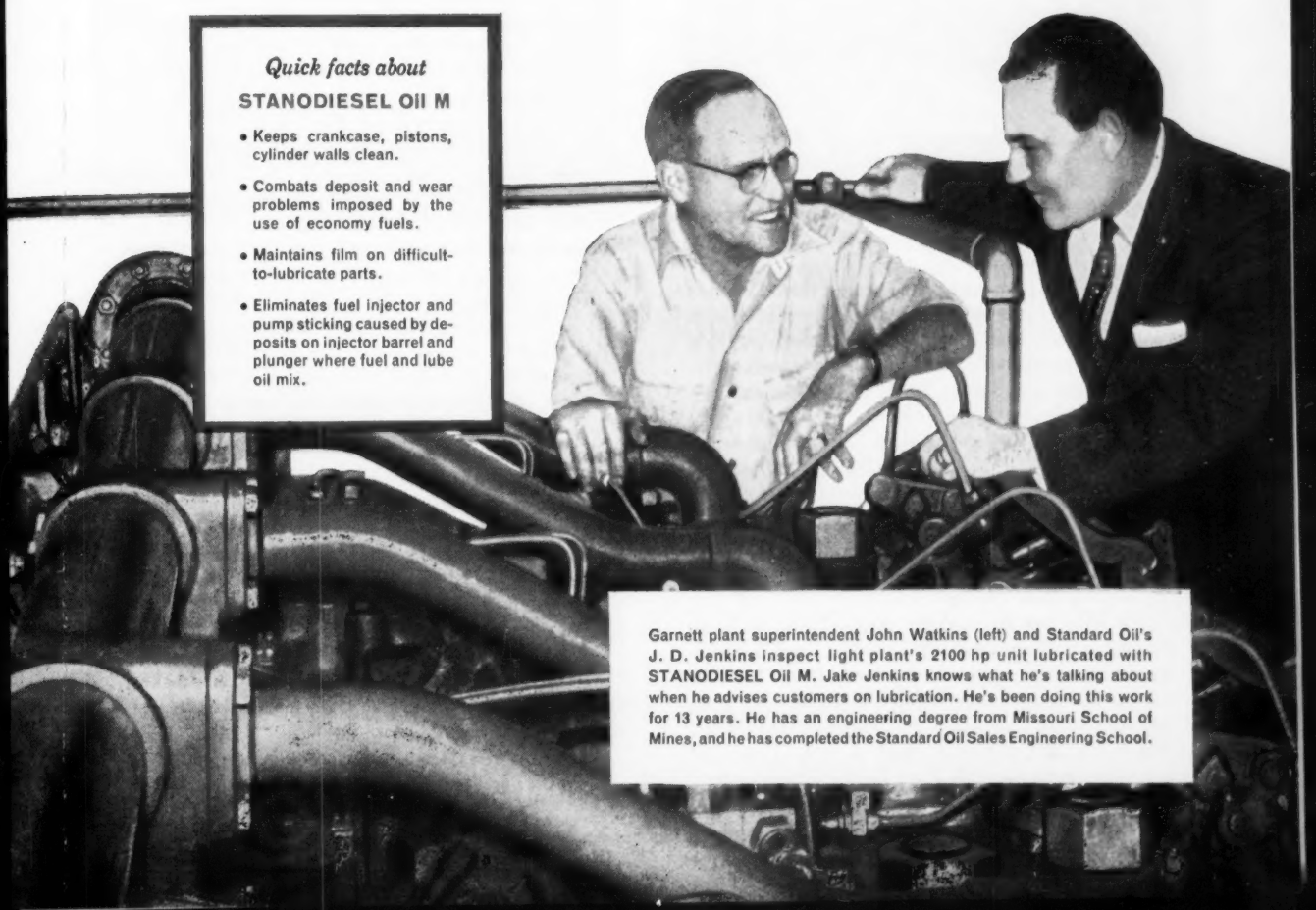
What has happened: At the Garnett plant, stuck rings and dirty pistons are unknown. The 1400 hp unit was in service nine years before reringing. Overhauls are made only every five years. The top performance from STANODIESEL Oil M and the technical service provided by lubrication specialist, J. D. Jenkins, have made possible first rate, uninterrupted, low cost electric service.

What you can do: The Standard Oil salesman near you in any of the 15 Midwest or Rocky Mountain states has the full story about STANODIESEL Oil M, and how it will perform for you. Call him. Or write, **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by the use of economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.



Garnett plant superintendent John Watkins (left) and Standard Oil's J. D. Jenkins inspect light plant's 2100 hp unit lubricated with STANODIESEL Oil M. Jake Jenkins knows what he's talking about when he advises customers on lubrication. He's been doing this work for 13 years. He has an engineering degree from Missouri School of Mines, and he has completed the Standard Oil Sales Engineering School.

Reserved for your comment

BOB BELLAS, Associate Editor

On this matter of being first

. . . In the April issue ("Powerscope," p 169) you indicate Westinghouse Electric Corp will build the first gas-turbine electric power station with completely automatic remote controls. This installation is scheduled to power an oil-storage and tanker-loading facility on Lake Maracaibo in Venezuela.

Our company has supplied the C A Electricidad de Caracas in Caracas, Venezuela (El Convento Power Station) a 20,000-kw 2-shaft gas turbine with completely automatic remote control. This unit was turned over to the utility during October 1958 with remote control using either gas or oil. In addition, we have supplied the British Columbia Electric, Port Mann Station, four 25-mw 2-shaft gas-turbine units also for complete remote control. The first unit went into operation in February 1959, the second later with two units under construction.

A G SWANSON, *Brown Boveri (Canada) Ltd*

. . . Although the statements made in the original news story were reviewed for accuracy before being released, we have had the story rechecked in light of Mr. Swanson's comment. We find—much to our embarrassment—that the Westinghouse gas-turbine electric power station mentioned is not the first plant with completely automatic controls.

We do not know where the first such plant is located, or who built it. We do know the gas-turbine electric plant Brown Boveri installed for Electricidad de Caracas was operating before we released our news story. Therefore our claim of being first must be rescinded.

This is the first time, in the more than 15 years that I have been in technical public relations at Westinghouse, that I can recall an unsupportable statement being made in a Westinghouse news story. I can assure you that in the future we will exercise greater vigilance than ever in our approval-to-publish procedure to preclude this happening again.

H C MCDANIEL, *Director*
Technical Information
Westinghouse Electric Corp

More about high-temperature cooling

. . . I have just finished the article "Step up your i-c engine performance" (May, p 202) and found it most interesting. I am sure you know Dow Chemical Co has been most interested in cooling by ebullition, having recently developed a freeze-point depressant, *Dowtherm 209*, for water used in such systems. It forms an azeotrope with water having an atmospheric boiling point of 209 F. In such cases we generally recommend that 53% *Dowtherm 209* be mixed with 47% water giving this azeotrope mixture (constant boiling), yet giving freeze protection down to –45 F. By increasing the concentration of our product to 60%, freeze protection can be had to –80 F.

In the past it was most difficult to obtain freeze protection in such engines, consequently they were rarely used in areas where freezing was a problem. Of course, with a liquid-cooled engine, we can use ethylene glycol. However, if ethylene glycol is used in an ebullient-cooled engine, the water fraction distills from the ethylene glycol. This means the vapor lines and condensate return lines will contain pure steam or pure water as the case may be, both subject to freezing should the system shut down in winter. Also, ethylene glycol will concentrate in engine.

In addition, you have defined high-temperature cooling as simply raising pressure on the jacket water system. This is true. But in so converting to being cooled by ebullition, we must also remove the circulating water pump and provide a steam separator and a vapor collection dome. Engine baffles must also be removed where they would have a tendency to cause hot spots by not allowing the vapors or bubbles to come straight through to the steam separator. This, as pointed out in the article, makes possible more uniform engine cooling than could be had with normal circulation of a liquid coolant through the engine.

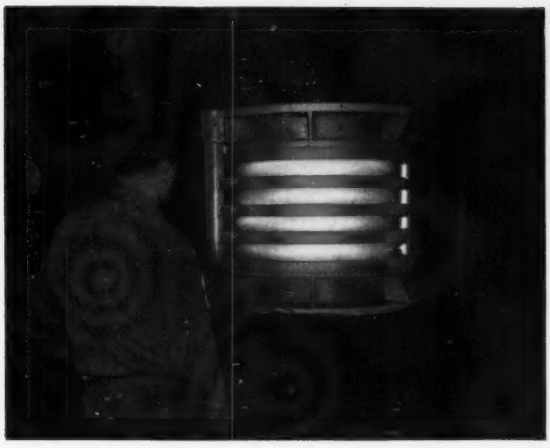
The article states circulating rates do not materially affect the temperature difference when high-temperature cooling is used. Engine makers' flow rates are always satisfactory for cooling at temperatures exceeding 212 F. In an engine cooled by ebullition, circulation rate is determined by the heat flux. That is, as engine load is increased, cooling is automatically increased by greater circulation of the coolant. And since the circulating pump has been removed, all circulation is natural. With the engine idling, circulation would be slow. However, under load, more heat must be removed so that the liquid boils more vigorously, increasing circulation through the engine and separator.

The importance of removing the circulating pump was pointed out by E O Freeman of Tidewater Oil Co when he stated that forced circulation tends to wash off the bubbles as they are forming. This would mean cooling by sensible heat and not absorbing by latent heat. It is the latter that makes such a system advantageous and also makes it possible to recover waste heat.

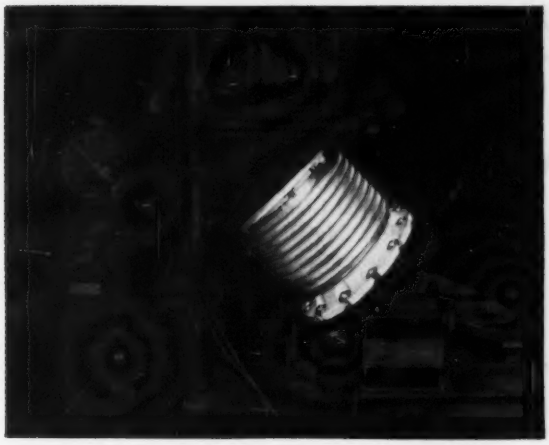
A R CONANT, *Engineering Chemical Sales*
The Dow Chemical Co, Midland, Mich.

continued

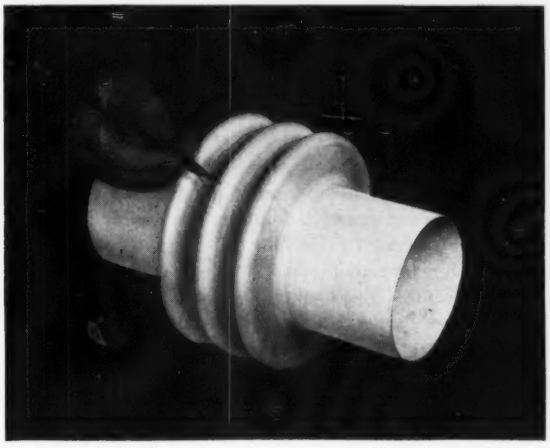
4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.



3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

For more facts circle 234 on Reader Service card, p 97

More **comment**

Why Pender is still alive

There are several factors that contributed to saving Pender's life ("My Biggest Boner," May, p 216). First, and perhaps most important, was the simple fact that bottom of the fuel oil tank was ten ft below ground. This meant cooler gases, poor circulation, lower oxygen content.

Second, the tank was almost empty. This tells us that the more volatile gases had already passed off and out the vent pipe. Third aspect relates to the construction of the lamp and the difficulty in mixing gas and flame.

JOHN M BASS, *Chief Engineer*
Wisconsin School for Boys, Waukesha, Wis.

He's against perforated pages

This is my first letter to POWER after many years of enjoyable and profitable reading. I believe you're getting better than ever. . . . I especially like the continuous reading feature eliminating the hunt through back pages for carryover of an article. But I don't like the perforated pages since it raises heck with my filing system.

PETER NEWMAN, *Engineer*
Moore McCormack Lines, Brooklyn, N. Y.

Keep piping color code simple

Whether a plant is large or small, a piping color code pays off in the form of greater plant safety, less time spent on maintenance and training.

Ours is a small plant so we paint the entire pipe length. On bigger installations it's more practical to use different colored bands, with a stenciled legend on each band to designate contents of the line. These bands are painted on the piping where it enters or leaves a building, at couplings and valves. Arrows indicate direction of flow.

But here's the point of this letter: steer clear of a color code that identifies a number of different liquids and gases. You will probably wind up with many different colors leading to possible confusion. For more information on this business of color coding piping refer to (1) "A Safety Code for Industry" available from E I duPont, (2) "A Scheme for Identification of Piping," American Standards Assn, (3) "Identifying Piping Systems," National Safety Council.

TOM MULLIN, *Seattle, Wash.*

A twist PTG . . . *electrically*

For some years I have been following in the pages of POWER the excellent editorial program being conducted in the field of industrial electrification. As a consulting engineer, now retired, I have the time to sit back and view objectively some of industry's shortcomings in planning for electrical growth.

My first observation—and probably the most important—concerns the smaller plant which does not have competent electrical people on the staff. True, you will often find an electrician in such plants. His work is generally confined, as it should be, to keeping the plant running electrically. He is rarely qualified to analyze growth problems which management may be totally unaware of. I'm thinking now of the insidious type growth problems which come about a little at a time.

All too often I have seen over the years the short-sighted attitude replacing true engineering. Eventually a complete and costly revamp becomes necessary when, in many cases, adequate planning would have saved significant sums of money—not mentioning the dollars lost through interruption of production when a complete redesign becomes the only thing possible.

This aspect of industry's problem has been stressed several times in your "Power to Grow" articles. However, for the small plant there is one very simple and practical solution. I'm thinking now of the important service that can be given to such plants by competent consulting engineers. If the management of the smaller plant would look upon the services of a consultant on a periodic basis as a form of practical insurance against possible downtime alone, I am sure the nominal fee involved could be more than justified. The consultant offers a wealth of diversified experience plus up-to-the-minute knowledge of application techniques. Further, his detached viewpoint would complement the day-to-day operating experience of the plant electrician. Here are a few of the services he could offer:

The consultant would make it his business to keep abreast of changes in available short-circuit current in utility feeders supplying the plant. Knowing the interrupting rating of key switchgear he could anticipate the time when a hazardous condition may be developing. He would be quick to spot the changing nature of a plant's load and recommend the steps which should be taken now to cope with it. Also, the consultant would always be available for telephone consultation on knotty maintenance and operating problems as they crop up.

As I look back over the years I've seen management think in terms of a consultant only when a major change becomes necessary. Actually there's a big area for service in the broad field which we might call the premaintenance area. Perhaps some of the younger consulting-engineer readers of POWER would want to take this thought a step further.

T H MURDOCK, *San Francisco, Calif.*

(Advertisement)

Some Straight Talk On Steam Trap Capacity

...or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counterclaims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

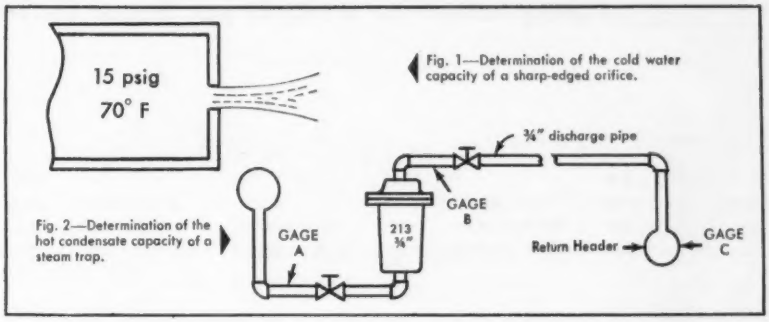


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hookups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8122 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For more facts circle 235 on Reader Service card, p 97

Power's data sheet

No. 324

Piping insulation weights per linear foot—double layer

Pipe size, in.	2-in. thick	3-in. thick		3½-in. thick			4-in. thick		4½-in. thick	5-in. thick
	Calcium silicate	Calcium silicate	1½-in. diatomaceous earth 1½-in. magnesia	Calcium silicate	1½-in. diatomaceous earth 2-in. magnesia	2-in. diatomaceous earth 1½-in. magnesia	Calcium silicate	2-in. diatomaceous earth 2-in. magnesia	Calcium silicate	3-in. diatomaceous earth 2-in. magnesia
½	1.44									
¾	1.424									
1	1.753									
1¼	1.687									
1½	2.397									
2		4.13	6.4			8.46				
2½		5.07	8.13			10.76				
3		4.83	7.59			10.5				
3½		6.05	9.73			12.23				
4		5.79	9.2		10.8	11.67				
4½		6.77	10.97		12.64	13.84				
5		6.41	10.2		11.87	13.04				
6				9.1	13.67	15.06	10.86	17.13		24.53
8				10.63	16.63	17.77	12.83	20.37	14.97	29.30
10				12.55	17.00	20.83	14.29	25.57	16.42	33.65
12				14.06	19.17	23.94	16.27	26.81	18.73	35.62
14				14.78	22.97	25.23	17.35	28.26	20.05	39.18
16				16.38	24.88	27.99	19.18	31.31	22.13	43.48
18				18.05	28.375	30.93	21.12	34.55	24.29	47.62
20				20.73	31.079	33.87	23.02	37.66	26.44	52.06
22				21.42	33.77	36.84	24.97	41.04	28.62	56.28
24				23.09	36.49	39.76	26.87	58.63	30.71	60.46

Sources: The Magnesia Insulation Manufacturer's Association Manual—Second Edition
Johns-Manville Data Sheets

Calcium silicate —density 11 lb per cu ft
85% magnesia—density 13 lb per cu ft
Diatomaceous earth —density 24 lb per cu ft

This second of two *Data Sheets* compares weights of three commonly used materials as double-layer insulation. For single-layer applications use *Data Sheet No. 323,* (POWER, July 1959, p 84) to calculate insulation loads on hangers.

GEORGE C HALZELL, *Boston, Mass.*

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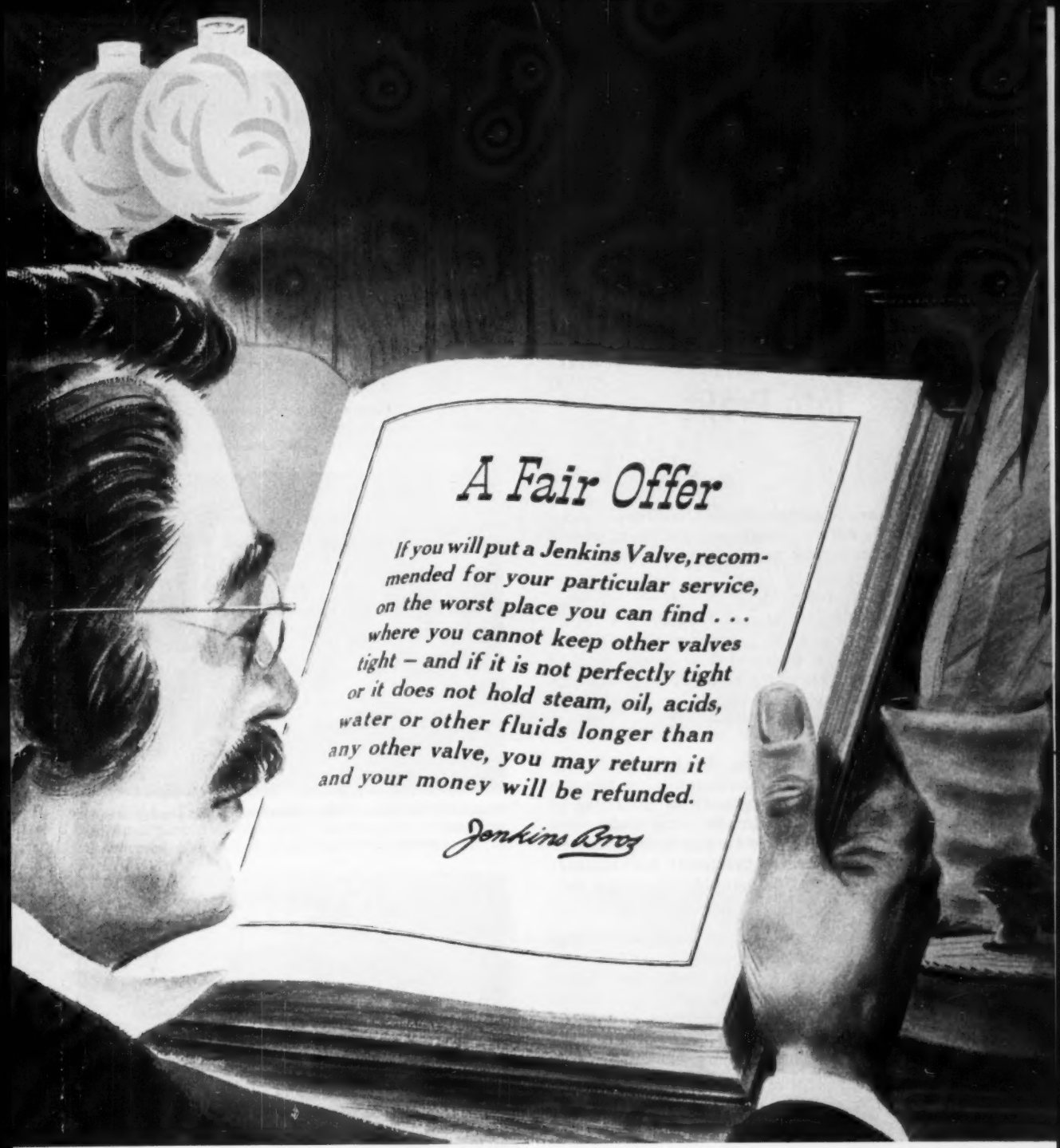
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If you will put a Jenkins Valve, recommended for your particular service, on the worst place you can find . . . where you cannot keep other valves tight – and if it is not perfectly tight or it does not hold steam, oil, acids, water or other fluids longer than any other valve, you may return it and your money will be refunded.
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SINCE 1864
Jenkins Bros

For more facts circle 236 on Reader Service card, p 97

How Commonwealth Edison Turned a Fly Ash Problem Into Profit

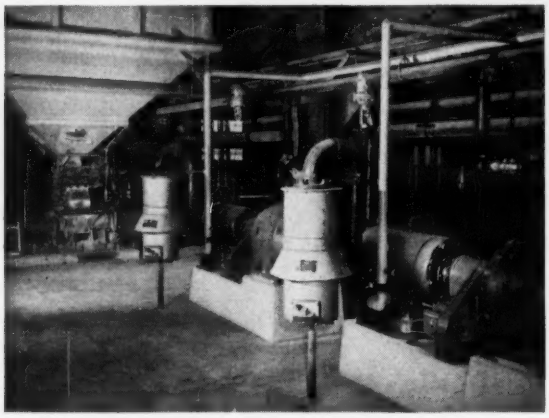
F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.

At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

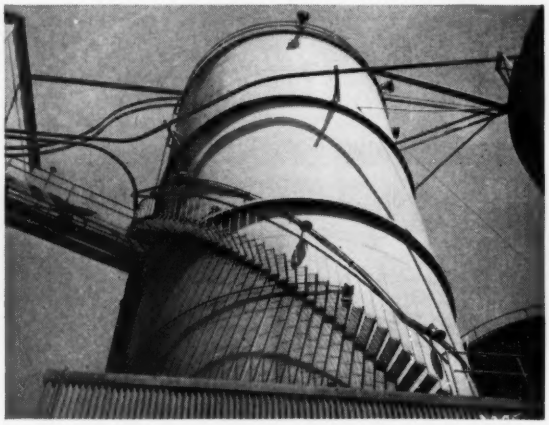
Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash.

Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

1335A
G-208 A

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For more facts circle 237 on Reader Service card, p 97

circle 238 on Reader Service card, p 97➤

How Blaw-Knox cuts your power piping costs

121,000 square feet of space at your service. Power piping facilities at Pittsburgh include 56,000 square feet of plant area and an additional 65,000 square feet for exterior storage. An additional new plant is located on a 15-acre site in Jackson, Mississippi.

Your job is under the personal supervision of an experienced engineer, who follows your project from beginning to end. Your piping is handled with the most modern equipment for welding, heat treating, and bending. Fabricating techniques, proven by rigid testing, are used.

New product development. Blaw-Knox developed an enclosed type of functional spring hanger as part of their complete line of hangers for supporting any piping system. Here a group of hangers individually designed for a project is factory checked to assure fast field erection.

Stress calculation cut from months to a day . . . with pace-setting engineering. An exclusive Blaw-Knox method uses an electronic computer for automatic computation with no limitation on the complexity of system. Full accuracy, with tremendous savings in time and cost. Write for details.

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BLAW-KNOX COMPANY

Power Piping Division

829 Beaver Avenue, Pittsburgh 33, Pennsylvania

Technical briefs . . . Latest engineering

Check construction, maintenance and heat-loss costs when you pick degree of power-plant enclosure

Which enclosure shall it be?, (A study of varying degrees of power-plant enclosures), *C D Birget and J H Kline, Commonwealth Associates, Inc*

Construction, maintenance and heat-loss costs are compared for identical plants proposed for (1) the Great Lakes area, with protection designed for –40 F and (2) a southern state, with protection designed for 0 F. Comparison includes enclosed, semioutdoor, outdoor and outdoor above grade enclosures.

Northern plant. Construction cost savings between enclosed and outdoor types range from a difference of $437,500 between enclosed and semioutdoor to $679,700 difference for outdoor above grade. Heat loss for semioutdoor will be $62,400 more than the enclosed station. Capitalized at 15%, this equals $416,000. For an outdoor above grade plant the increase is $499,200. Capitalized maintenance differences range from $204,000 to $306,000. Total increase in capitalized cost is $182,500 for the semioutdoor and $125,000 for outdoor above grade enclosures.

Southern plant. Here the figures reverse. Decrease in building costs goes from $437,500 for semioutdoor to $870,700 for outdoor above grade. Capitalized heat loss spreads from $370,000 to $443,000, and capitalized maintenance goes from $204,000 to $306,000. Figures result in an increase of $136,500 for the semioutdoor, but a decrease in capitalized cost of $81,800 for the outdoor and $121,700 for the outdoor above grade enclosures. *APC paper 4/1, 7-C*

Steam plants

Generating station coal bunker explosions—their cause and prevention, *W W Hagnauer, Commonwealth Edison Company and K W Hamming, Sargent and Lundy*

Bunker explosions at the Ridgeland Station of Commonwealth Edison Company in 1951 and at that company's Will County Station in 1958 touched off a research program on the causes of such explosions.

Conclusions reached are based on Illinois coals. These release methane gas when crushed or disturbed in the pile, creating a potential explosion hazard. Warm or hot coal speeds gas release, and if fire is present, CO is added to the gas collection. Add enough air, shift the coal to expose glowing coals, and the mixture explodes. This was the cause of the bunker explosion at the Will County Station.

The 1951 blowoff came about through gases being ignited by static from conveyor belts. There was no ventilation equipment, so the gases were allowed to collect under the bunker roof until an explosive mixture was reached.

In neither case did the explosion damage the bunker. Partially burned gases, driven out of the bunker area by the initial explosion, released their full effect on the room above.

Design points promoting bunker safety are: provide a ventilation system to deliver 2 cfm air per ton of coal in the bunker (to keep methane well below explosive limits) and at velocities of 3500-4500 fpm (to prevent low-velocity areas permitting dust settlement). Bunker side slopes should provide valley angles of not less than 55 degrees, and with bunker symmetry if possible. Otherwise coal hang-up may occur. All bracing, ladders in the bunker should be away from walls to avoid collection on surfaces. Static-free coal belts above bunkers and CO_2 system should also be included in design.

Suggestions cover high volatile midwestern coals. Details on design as well as suggested operating procedures present a case for prevention of bunker fires. *APC paper 3/31, 5-C*

Ultrasonic testing of large steam-turbine parts, *L E Smith, Tennessee Valley Authority*

Sonar is used to find submarines. Ultrasonar, called *ultrasonics,* is used to find flaws in materials and equipment. Both use the same principle: an energy charge beamed into an object keeps going until it reaches a change in the object's material. This change could be the far end of the object, a flaw or anything that could reflect the beam back to the sending device. If you get a reflection and if you know the beam's velocity, you can tell how far it is from the end of the part to the flaw or crack that caused the reflection.

General principles of ultrasonics and some applications in field testing of generator parts are described. *ASME paper 59-APWR-1*

Electrical systems

Fuse protection of high-voltage power transformers, *R A Larner, K R Gruesen, Texas Electric Service Co*

Low installation cost, simple maintenance, reliable protection are key reasons for increased use of power fuses for power transformer and associated equipment protection. On the other hand, there are deficiencies that should be balanced against the carrying charges of more expensive methods.

Power fuses used for protection should have an interrupting capability at least equal to the duty imposed. Also, the fuse time-current curve in the critical area should be similar to the transformer

safe-heating curve. This is important not only for transformer protection but also for coordination with other protective devices between transmission line and customer.

Fuses rated above 22 kv may suffer corona damage to fuse elements and their flexible leads. Exposure to both moisture and corona action for long periods can bring about the damage. Adequate shielding against these effects is needed to avoid trouble.

Many of the concepts of fuse application are presented in the paper, which is based on a study of fuse performance over the past 30 years. *AIEE paper, 59-212*

The analysis of sudden short-circuit oscillograms of steam-turbine generators, *D Harrington, J I Whittlesey, General Electric Company*

Sudden short-circuit tests made on synchronous generators determine test values for certain reactances and time constants. Test consists of suddenly applying a short circuit to armature terminals of the generator when operating at rated speed, at full or partial voltage and at no load. Instantaneous armature current values, recorded by oscillogram, yield test values of transient and subtransient reactances and time constants.

Oscillogram analysis is exacting, laborious and time consuming. Many oscillograms are needed to get good test values. To overcome these drawbacks a method has been established for using a Benso-Lehner oscillogram trace-reader, model "Oscar E," to obtain required data from the oscillograms, and IBM 704 electronic data-processing machine to analyze the data. The method has proven out on two recent generator short-circuit tests and for reanalyzing data taken during several previous tests. *AIEE paper 59-54*

High-capacity isolated phase buses—laboratory and field test experience, *G E Buchanan, Delta Star Electric Div, H K Porter Company*

High currents normal to large generators are creating problems in connection with the isolated phase generator bus. One is induced and magnetic heating, the other field pressurizing of bus systems.

Typical buses were tested between 11,000 and 15,000 amp to study these problems. Tests and results are reported. Conclusions drawn are: (1) Self-cooled isolated-phase bus designed for 11,000 amp can operate as high as 15,000 amp, but operators must recognize that a high temperature in the covers is not a cause for inspection or an indication of failure. (2) Structural designer must recognize that induced heating in both large and small structural members will occur, and effect of heating on concrete surrounding these members must be considered. (3) Induced heating in reinforcing rods may be excessive and a nonmagnetic rod may be a necessity. The nonmagnetic rods, in turn, must be insulated against an electrical loop. (4) Other magnetic material close to the bus may heat up. This should cause no trouble unless station personnel normally come in contact with the heated part. (5) If a hot spot occurs in an inaccessible place, there may be cases where it can be ignored and the average temperature becomes important. (6) Hermetically sealed buses aren't practical today, but if present-day buses are installed with care, they are tight enough to be pressurized without losing too much gas. *AIEE paper 55-498*

Directions for ordering these papers on page 97

Industrial boilers

The economics of air preheat on industrial boilers, *C L Brown, The Air Preheat Corporation*

Fuel cost, amount of heat recovery, equipment cost and equipment installation determine results of heat-recovery equipment evaluation.

An economic analysis of adding a preheater to an existing boiler in a southern paper mill showed payout times of between 1.64 and 0.92 years. This yields a return on capital invested of between 61.3% and 108.7%. Returns and payouts were based on a boiler efficiency increase of 10%.

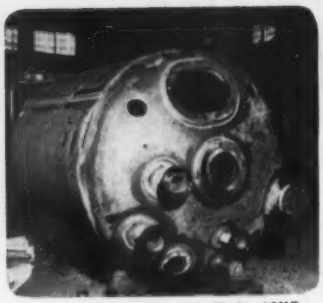
Boiler in question originally fired only fuel oil. It was converted so it could fire either coal or oil at the start of World War II. But they still used oil, since oil shortage did not hinder operation. In 1956 fuel costs swung boiler to coal firing. During the changeover both a preheater and dust collector were added.

After preheater was installed tests were run to find dollar savings. Payoff times, above, are based on fuel costs of 25-40¢/10^6 Btu.

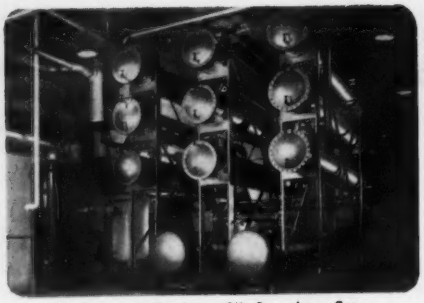
Tests compare oil burning with and without the preheater and coal burning with the preheater. Since tests couldn't be run using coal without the preheater, calculations were substituted for actual data. Results show boiler efficiencies of 84.85% and 73.56% for oil with and without preheater, and 83.75% and 73.9% for coal with and without preheater. *APC paper 4/2, 8-a*

New developments in fuel-burning equipment for industrial plants, *A W Jackson, The Babcock and Wilcox Co*

For utilities, fuel converted to steam is the basic raw material in the manufacture of the product—electricity. In most industrial plants, however, the



Frick reactor shells are built by ASME qualified welders.



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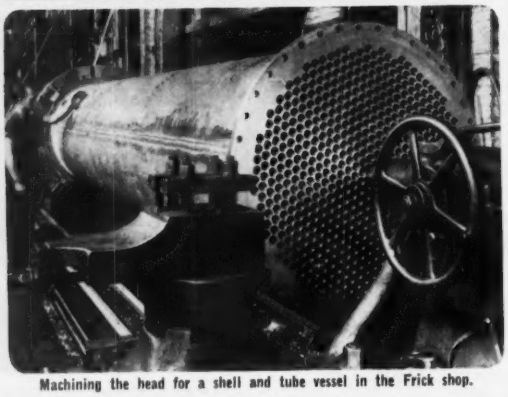
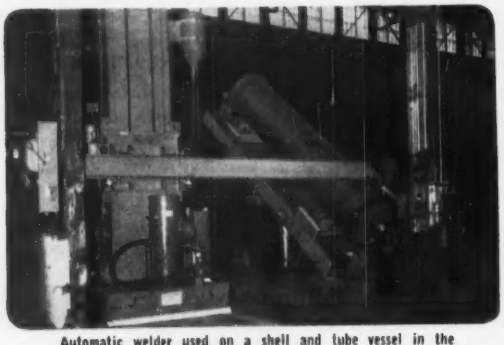
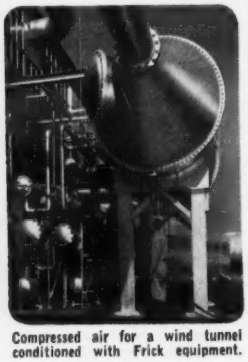


Machining the head for a shell and tube vessel in the Frick shop.



Automatic welder used on a shell and tube vessel in the Frick shops at Waynesboro, Penna.



Compressed air for a wind tunnel conditioned with Frick equipment.

Technical briefs

Begins on page 86

cost of producing steam for process and power is usually a small percentage of the total cost of the raw material entering into the product—manufactured goods. In the second case output of goods depends on an adequate and dependable steam supply. Thus the emphasis in industrial firing equipment design is on dependability.

Author describes modern fuel-burning equipment, illustrating how it differs from older models. Included are multifuel burners, jet ignition stoker, Vibragrate stoker, Rotograte stoker and the Cyclone furnace. *APC paper 4/2, 8-B*

Lubrication

A field study of gas-engine lubricants, II, *C M Floyd, Humble Oil and Refining Company*

In recent years the high-speed high-output gas engine has come well into the power picture. And getting continuous and economic operation from these engines has depended on development of suitable lubricants.

Most gas-engine installations contain both 2- and 4-cycle engines. Therefore operators need an oil that will serve both engines for long operating periods. To find the best crankcase oil and the best operating procedure, Humble Oil conducted tests on their gas engines in the Gulf Coast area.

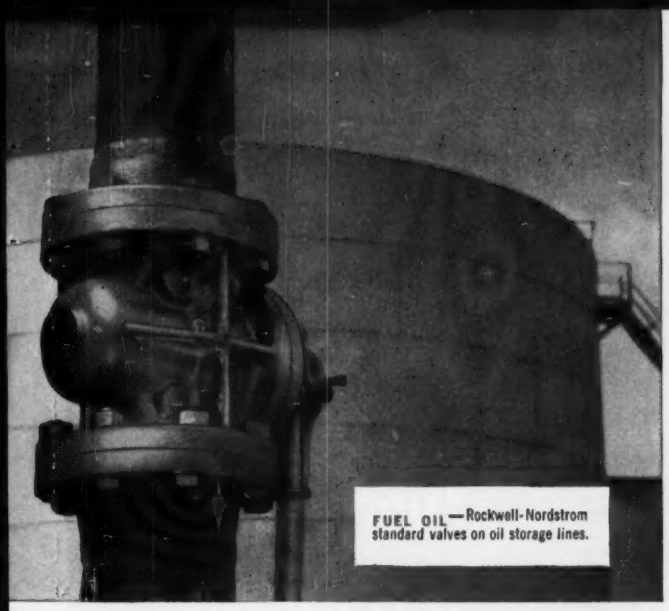
Results indicate: (1) A detergent intermediate VI naphthenic base oil does well for the engine types. (2) Detergency is needed in 2-cycle units to keep rings free and ports open and in 4-cycle units to keep engines clean and oil rings open. (3) Draining crankcase and changing filter at 2000-hr intervals (instead of changing filters every 720 hr and oil at 8000-hr intervals) will pay for the use of top-grade oils instead of straight mineral-based oils. Although the oil is not recommended for power cylinders after 2000 hr it is still acceptable for use on the less critical compression cylinders. *ASLE paper 59AM 4B-3*

Reducing leakage from hydraulic systems, *R Q Sharpe, Socony Mobil Oil Co*

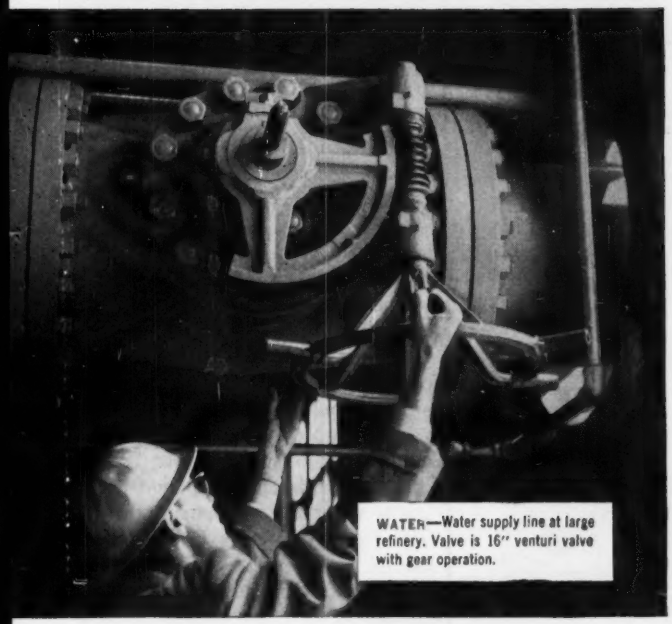
Many people believe that large high-pressure hydraulic systems will leak

For more facts circle 239 on Reader Service card, p 97

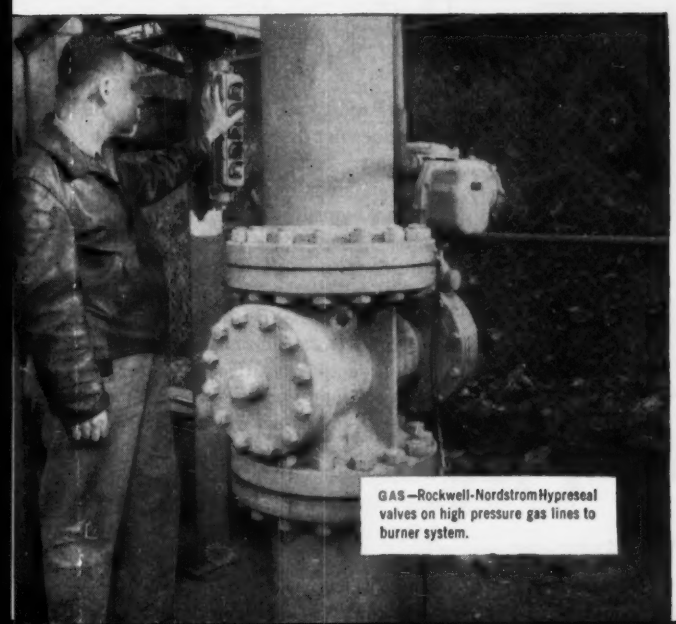
circle 240 on Reader Service card, p 97



FUEL OIL—Rockwell-Nordstrom standard valves on oil storage lines.



WATER—Water supply line at large refinery. Valve is 16" venturi valve with gear operation.



GAS—Rockwell-Nordstrom Hypreseal valves on high pressure gas lines to burner system.

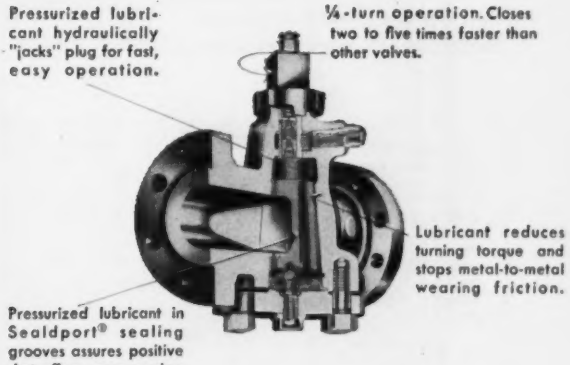
WHAT DOES LUBRICANT DO IN A ROCKWELL-NORDSTROM PLUG VALVE?

Pascal's Law* explains how Rockwell-Nordstrom lubricated plug valves can assure more dependable operation and tighter shut-off than non-lubricated valves. Too often, the lubricant is thought of as just a means of easing operation. Actually, the lubricant, under pressure, creates a closed hydraulic system that can minutely jack the *tapered* plug from its seat for instant operation. Also, pressurized lubricant forms positive pressure seals at each plug port to assure positive shut-off on any fluid. Finally, lubrication prevents wear and assures the economy, long life and dependability that can only be expected from a lubricated mechanism.

Advantages for Power Engineers:

For the main ingredients of power . . . gas or liquid fuel and water . . . Rockwell-Nordstrom valves will give you better flow control at far lower cost. Here's why they shut-off positively on *any* line material : . . you can throttle or shut-off with one valve . . . there's no up stream or down stream side for positive shut-off . . . they're more compact than other valves and can be installed in any position . . . they open or close with just a quarter-turn and lubricant keeps them ready for instant operation . . . *and* Rockwell-Nordstrom valves cost about the same, often less, than other valves. They are available in a complete range of sizes from ½" to 36", with a variety of power operators and operating accessories.

It costs nothing to get the facts. Write for full details or ask for a Rockwell Field Engineer to call: Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee: Peacock Brothers, Limited.*


Pressurized lubricant hydraulically "jacks" plug for fast, easy operation.
¼-turn operation. Closes two to five times faster than other valves.
Lubricant reduces turning torque and stops metal-to-metal wearing friction.
Pressurized lubricant in Sealdport® sealing grooves assures positive shut-off on every service.

*Pressure applied to a confined fluid is transmitted uniformly to all areas of the confining fluid.

Lubrication makes the difference

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Life in these excited states...

"Sunday morning is no time to call me about a little leak"

For Men Who Work 24 Hours a Day

Like the phone ringing when you're in the shower, corrosion and contamination wait for no man. Best way to confine it to normal working hours is to specify trouble-free Ace chemical-resistant equipment by American Hard Rubber Company. Best for the money anywhere... backed by 108 years of experience.

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*

Improved design . . . now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*

Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57.*

World's best chemical valves . . . at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ⅛" pet cocks to 24" gate valves.

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
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Technical briefs

Begins on page 86

considerably regardless of what you do—and their systems leak a lot. Others have found that planned maintenance programs cut leakage so much it is no longer a major nuisance. Their systems also leak, but very little. They've cut cost of fluid replacement and cleaning operations, and they've cut downtime.

The key to a good maintenance program is education of the men responsible for the hydraulic systems. Author presents several basic do's and don'ts about seals, packings, fluids, hoses, finishes and their effect on the system if misapplied. He also discusses ways to set up programs, who is involved and what should be done to keep hydraulic-system leakage to a minimum. *ASLE paper 59AM 2C-2*

Conditioning of vacuum pump oils, *G F Bowser Company*

Oil is used in vacuum pumps for sealing as well as lubrication. To get good sealing, an oil with low vapor pressure is needed, or backpressure on the pump goes up. Yet even if the right oil is used it still becomes contaminated by air, gases, moisture and condensable vapors that contact the oil. Contamination increases the oil vapor pressure and eventually the oil must be replaced.

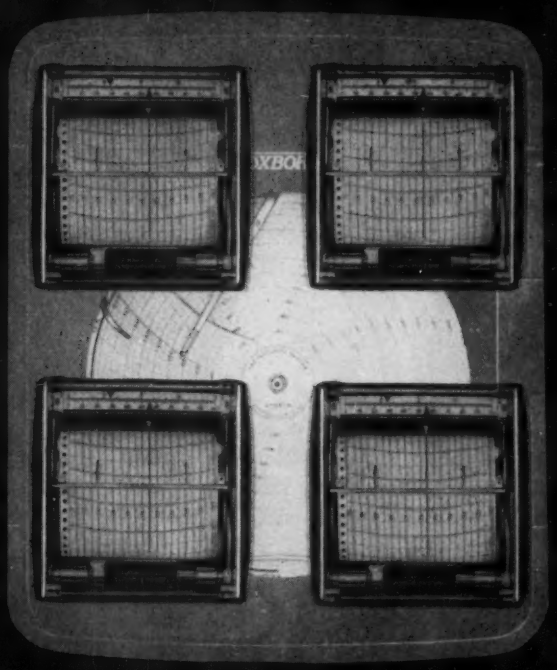
Added to the contamination problem is vapor release from the oil itself. Release of gases coming from the oil cuts useful displacement of the pump. If the release becomes high enough all the pump capacity is used to remove oil vapors.

Several solutions to these problems, all involving oil purification, have been tried. Heating the oil drives off gases but oxidizes the oil and does not drive off dissolved gases and air. Settling, centrifuging, filtration partially remove free liquids but not emulsified liquids or dissolved gases. Gas ballast reduces dissolved liquids present but boosts gases.

A new solution is vacuum purification in simplified form. System combines a vacuum chamber, heater, double-acting positive-displacement rotary pump to separate contaminants from oil and then get rid of them. Paper describes system in detail. *ASLE paper 59AM 1C-2*

continued

SAVE 75% OF YOUR PANEL SPACE without SACRIFICE OF FULL-SCALE RECORDS!



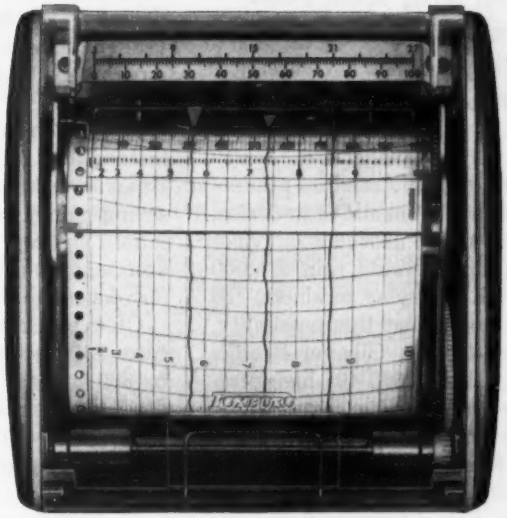
Foxboro CONSOTROL* Recorders

Yes, you can actually mount up to 4 Foxboro Consotrol Receiver-Recorders in the panel space ordinarily required for one conventional-size instrument — and get a full-scale, 4"-wide chart record from each one! Or, using 3-pen Consotrol Recorders, get a total of 12 full-size records in the same panel space!

This unique combination of compactness and high readability is in *addition* to the outstanding convenience Consotrol Recorders provide. They're by far the simplest to maintain . . . inking only once every 6 months; chart replacement every 30 days. And the chart loads quicker and easier than a box camera!

With Consotrol Recorders you can put records of *all* important trends on the board without crowding or limiting visibility. The same compact Consotrol design also is available with automatic control functions. Get full details on the complete modern Consotrol Line. Write for Bulletin 13-18. The Foxboro Company, 688 Neponset Ave., Foxboro, Mass.

*Reg. U.S. Pat. Off.



(½ actual size)
Available in 3-27 psi or 3-15 psi air signal

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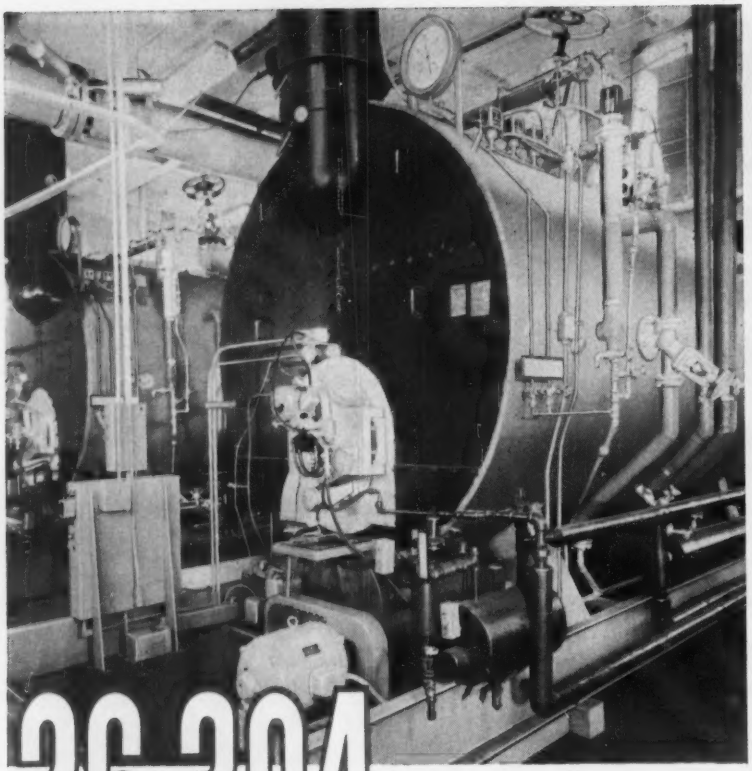
CONSOTROL PNEUMATIC INSTRUMENTS

For more facts circle 242 on Reader Service card, p 97



26,304 hours of dependable process steam

Except during annual 2-week vacations, these Cleaver-Brooks packaged boilers have operated continuously for 3 years

At C. F. Mueller Co., Jersey City, largest American producer of macaroni and egg noodles, even a brief unscheduled boiler shutdown would ruin $15,000 worth of drying products. To insure against this possibility, two 400-hp Cleaver-Brooks Model LR-600-40 high-pressure boilers were installed for low-pressure operation.

These packaged boilers, which also supply steam for the firm's plant-heating system, operate 24 hours a day, 7 days a week for 50 weeks a year. C. F. Mueller Co. officials report very little maintenance is required.

This is one of hundreds of installations in which Cleaver-Brooks packaged boilers are saving money on initial installation, upkeep, long-term investment, and day-in and day-out dependability.

Cleaver-Brooks manufactures 130 packaged boilers, 15 to 600 hp, gas, oil or gas/oil fired. For details on any application, call your representative or write Cleaver-Brooks Company, Dept. J, 301 E. Keefe Ave., Milwaukee 12, Wis.

Cleaver Brooks®

ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

Technical briefs

Begins on page 86

Miscellaneous

Atmospheric gas-fired infrared heaters for processing applications, *Marck Resek, consulting engineer*

Infrared heaters do away with the middleman; they heat objects without heating the air between. Two most popular types are electric and gas fired.

Drawbacks of the electric units are limits of auxilliary equipment (power lines and transformers) and cost of power if large quantities of heat are needed. Previously gas units' main disadvantage was the fact that pressurized lines were needed to mix air and gas for firing. A new gas-fired unit, invented in Germany and now manufactured and distributed in the U.S., does away with this trouble since line pressure is high enough for good operation. Heating efficiency is 60% at 1650 F; this and other design data are supplied in detail. Typical applications: heating men, machines and the floor in larger work areas; thawing frozen coal or ore cars; heating dies and other objects in manufacturing processes. *ASME paper 58, 4-210*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources. Order complete paper from the source, not POWER.

American Society of Mechanical Engineers (ASME). Obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers (AIEE). Obtainable from AIEE, 33 W 39th St, New York 18, New York.

American Power Conference (APC). Papers will be published in book form, obtainable from Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

American Society of Lubrication Engineers (ASLE). Available from ASLE, 84 Randolph St, Chicago 1, Ill.

For more facts circle 243 on Reader Service card, p 97

84,000 Hours of Reliable Viewing

. . . that is the Story of Dependability Behind Diamond's Television Camera Tube

Nor is the Story Finished. The ORIGINAL TUBE, installed in 1949, is Still in DAILY OPERATION!

At the Wood River Station of the Illinois Power Company, Diamond's "Utiliscope" Television system has provided 100% available viewing since 1949. In this job, dependability is all important! Only Diamond builds the tube which makes this availability possible.

The operator, in the control room, sees the boiler water level at the drum by viewing the Diamond monitor mounted in the control panel. Water level information is instantly and accurately available at all times from any viewing position in the control room.

Routine maintenance is the only service required since installation. "Old Reliable" has a record of more than ten years of operation and is continuing to provide reliable service.

Such performance is not unusual for Diamond's "Utiliscope" equipment. This Heavy Duty Television is designed for industry. It is dependable, durable, resistant to time and difficult operating conditions. It is saving money and improving operation in power plants, steel mills, foundries, mines and a wide variety of manufacturing plants.

Write us for a non-obligating survey of your plant by our industrial television specialists. Electronics Division, Diamond Power Specialty Corporation, Lancaster, Ohio.

8310

Diamond

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LANCASTER, OHIO *Diamond Specialty Limited, Windsor, Ontario*

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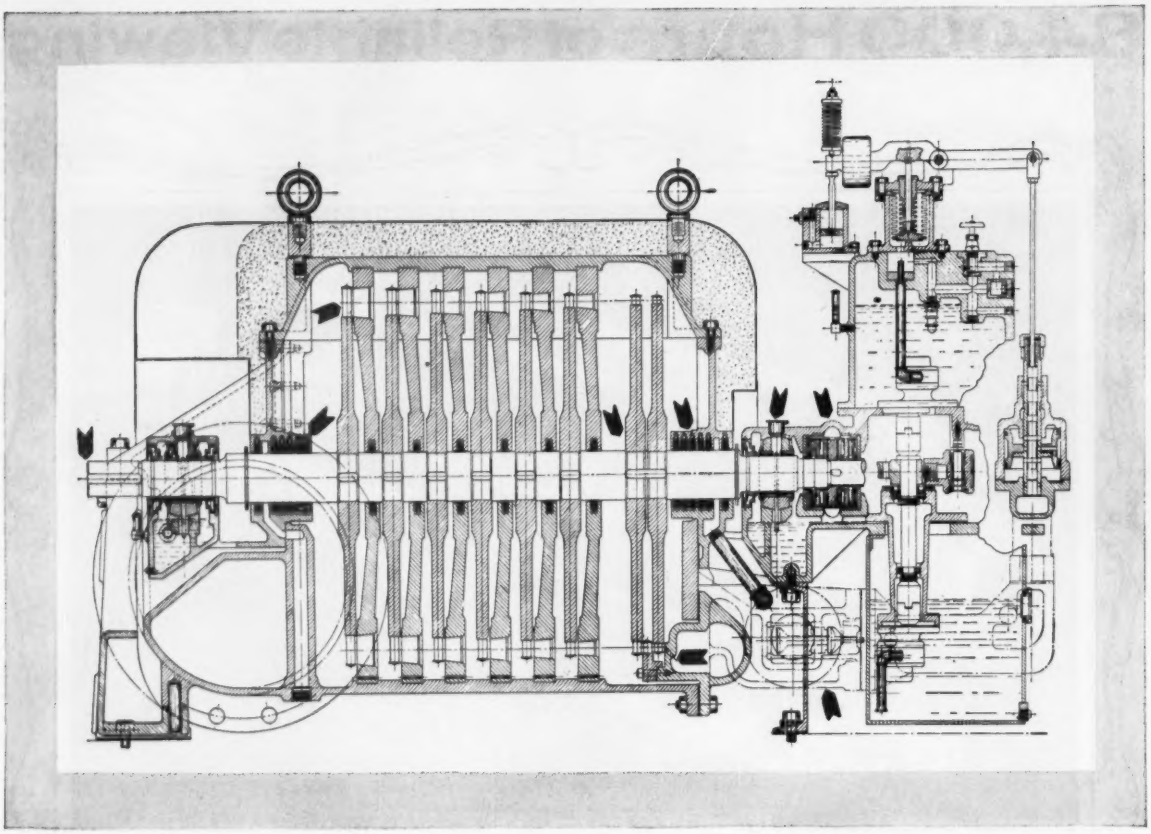

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- Spherical seated sleeve bearings.
- Kingsbury thrust bearing.
- Center line support.
- Carbon ring gland seals.
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- Choice of speed governors from simple mechanical type to precision oil relay.
- Bolt type overspeed trip governor.
- Steam conditions to 600 PSIG and 750°F.
- Condensing or non-condensing.

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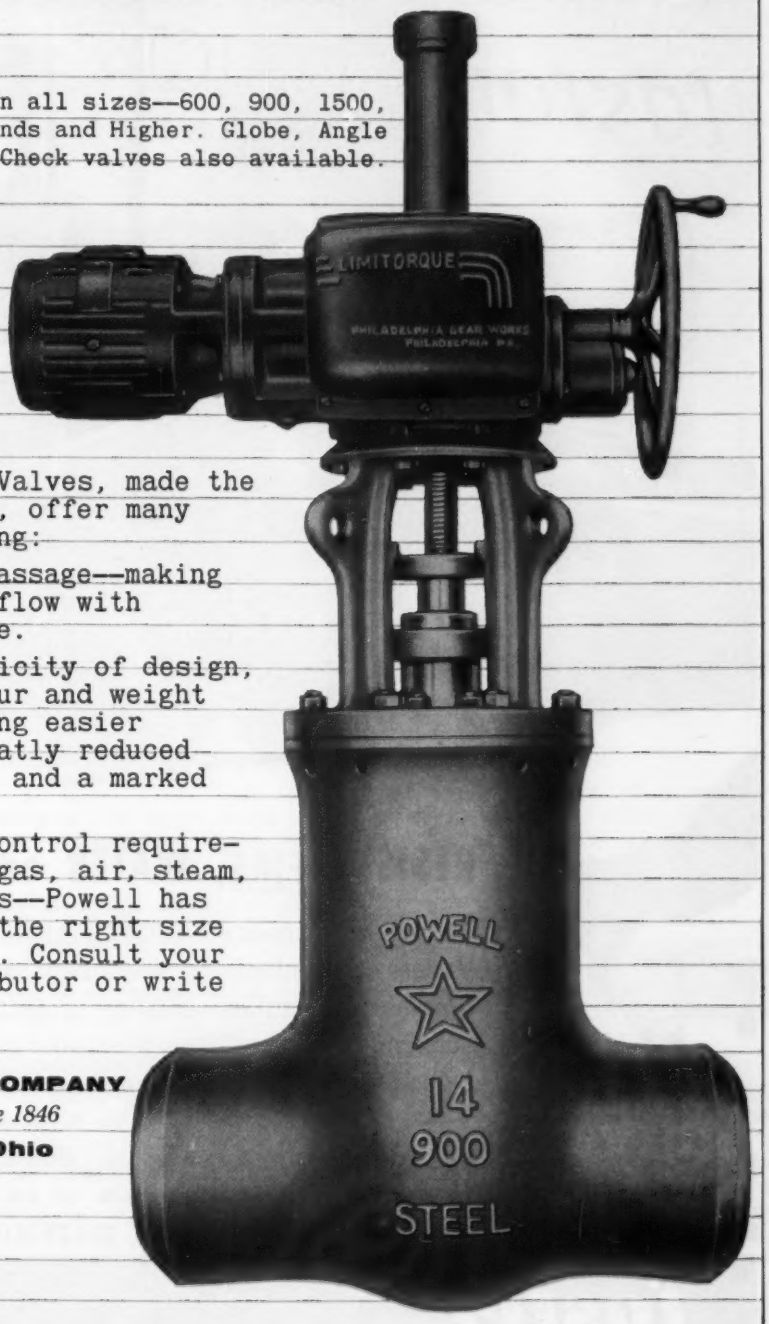

Pressure Seal Gate Valves, made the superior Powell way, offer many advantages—including:

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* Outstanding simplicity of design, smooth body contour and weight reduction—assuring easier installation, greatly reduced insulating costs, and a marked saving in space.

For all your flow control requirements—water, oil, gas, air, steam, and corrosive fluids—Powell has the right valve in the right size and the right metal. Consult your local Powell distributor or write directly to us.

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Dependable Valves since 1846
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POWELL...world's largest family of valves

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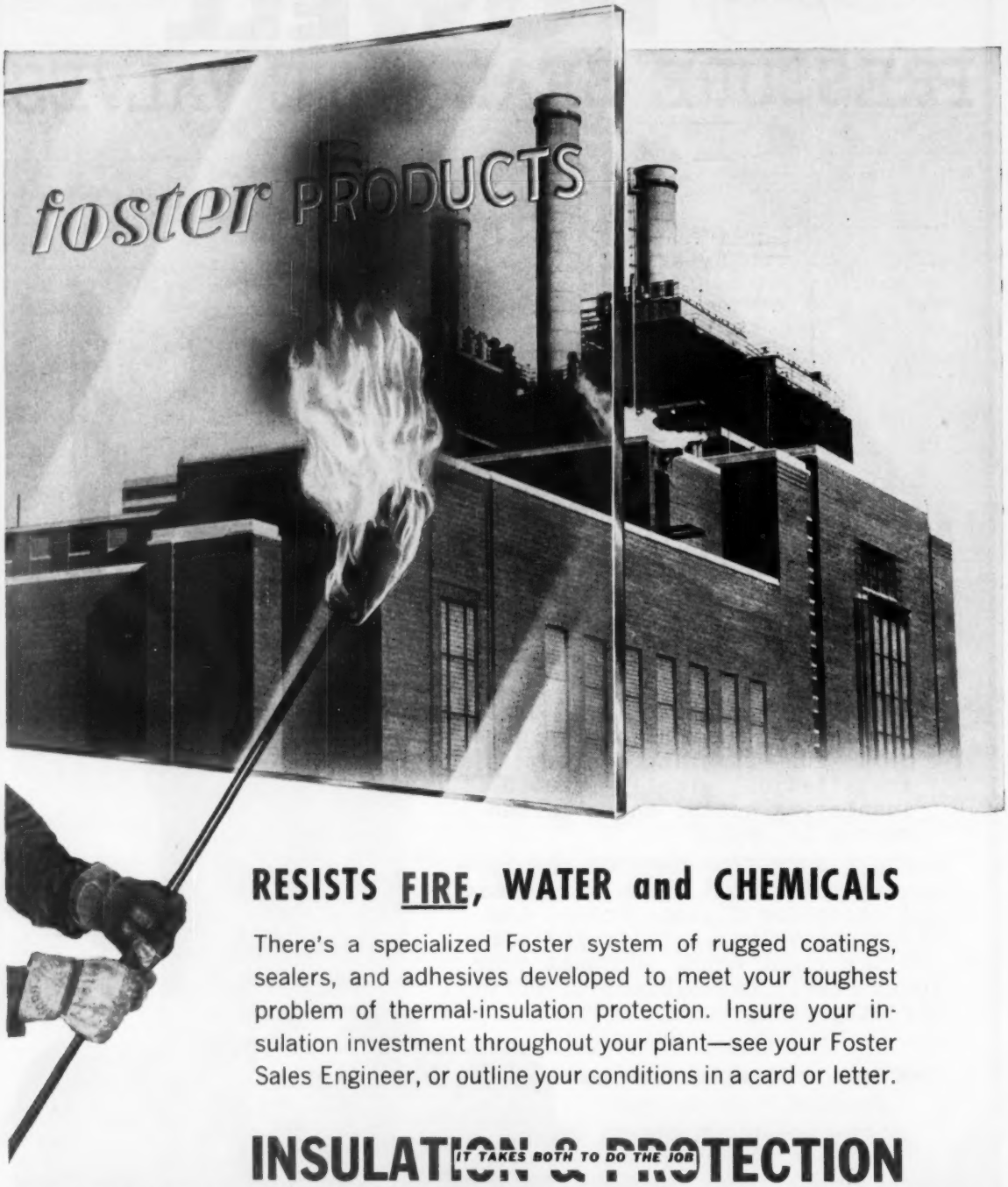

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51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NEW LITERATURE listed in this issue, starting on p 98

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
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New free literature

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATION

101 **Central-station** air conditioners, draw-through units in horizontal and vertical arrangements, are topic of 40-p catalog 1209. Tables, charts, dimensional drawings and photos, a sample problem and typical specs are included. Clarage Fan Company

102 **Direct-fired heaters** for all capacities, fuels, applications and mountings are discussed in 4-p bulletin 501. Arkos Manufacturing Company

103 **Unit heaters,** horizontal and vertical type, are described in 12-p catalog 1103. Tables list basic data; steam, hot-water and sound ratings, dimensions. Clarage Fan Company

104 **Gas-fired intake units** supply tempered makeup to replace air removed by industrial exhaust systems—2-p bulletin A-115 gives details. Hartzell Propeller Fan Company

105 **Refrigeration compressors,** heavy-duty 4-cylinder models, are discussed in 20-p bulletin 651-C. Plant photos show applications, drawings illustrate features. Frick Company

106 **Rotary compressor** boosted freezing capacity for one plant—4-p bulletin gives details. Freezing Equipment Sales, Inc

107 **Dynafoil fans** for heavy duty are listed in 8-p bulletin 859. Dimensions, efficiencies and features are given. Clarage Fan Company

108 **Pressure fans** are covered in 20-p booklet 857. Four pages of graphs aid selection. Clarage Fan Company

109 **Fan wheels** and assemblies are topic of 6-p folder 614. Clarage Fan Company

METALS AND MATERIALS

110 **Wrought-iron alloy** containing manganese is described in 8-p booklet — working properties, corrosion data are included. A M Byers Company

111 **Acid-resistant valve alloy** is discussed in technical bulletin 8. Alloy Steel Products Company, Inc

112 **Nickel-base alloy** useful in corrosive environments involving h-t fluorides is detailed in 12-p developmental-engineering booklet. Haynes Stellite Company

COMPRESSORS AND ACCESSORIES

113 **Air-cooled compressors** in 15- to 125-hp, 81- to 641-cfm range are subject of 16-p bulletin A-56. Cross sections show various types. Joy Manufacturing Co.

114 **Packaged field compressors** are detailed in 28-p bulletin 158. Balanced/opposed compressor, positive direct drive, vertical air-flow radiator are illustrated. Clark Bros Co

115 **Industrial compressors,** heavy-duty models in six sizes from 350

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to 1250 hp, 2418 to 7392 cfm are covered in 12-p bulletin A-73. Joy Manufacturing Company

116 **Compressed-air filters** are described in 2-p data sheet. Fram Corporation

MATERIALS HANDLING

117 **Plate magnets** for existing equipment are detailed in 8-p bulletin 1074. Tables speed selection. Stearns Magnetic Products

118 **Block and sheave specifications** are given in 10-p catalog 1. Tonnage capacities, recommended wire-rope sizes are included. Sauerman Bros, Inc

119 **Traveling cranes,** overhead electric types, are studied in 8-p engineering-data bulletin ED-205. Northern Engineering Works

ELECTRICAL GENERATION, TRANSFORMATION AND CONVERSION

120 **Synchronous-generator** construction features are explained in 6-p bulletin 05B6139B. Allis-Chalmers Manufacturing Company

121 **Substation transformers** rated single phase, 500 kva, 15 kv and below are topic of 8-p publication GEA-5452A. Includes a table of weights and dimensions. General Electric Company

122 **PVC-insulated leads** for oil-filled transformers are discussed in 8-p bulletin RCT 320. Rome Cable Corporation

ELECTRICAL DISTRIBUTION AND PROTECTION

123 **Electrical connectors,** plugs and receptacles in environment-resistant construction are described in 48-p bulletin 2711. Dimensional drawings, tables of contact inserts, components and accessories are included. Crouse-Hinds Company

124 **Flame-retardant polyethylene** for wire and cable is subject of 12-p technical paper. Contains ten tables and charts, a bibliography. Rome Cable Corporation

ELECTRICAL APPLICATION

125 **Lighting specs** are detailed in 44-p booklet. Incandescent, mercury-vapor and fluorescent info is included. RLM Standards Institute

126 **Pressure switches** are detailed in 36-p design handbook. Each page describes a specific type—diaphragm, bourdon tube or piston. Glossary of terms, selection tables and operating data are included. Barksdale Valves

127 **Ac and dc standard motors,** special motors, gearmotors and adjustable-speed drives are listed in 8-p bulletin 2650. The Louis Allis Co

128 **Storage-battery facts** are discussed in 32-p booklet, which covers general info on tests, ratings, construction and chemistry. The Electric Storage Battery Co, Exide Automotive Div

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NEW LITERATURE listed in this issue, starting on p 98

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
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129 **Rheostats,** tubular slide-wire type, are studied in 12-p bulletin 41. Photos, charts, dimensional drawings and diagrams give details. James G Biddle Co

130 **Electrical-measuring** instrument selection and use in experimental labs is covered in 8-p reprint Z-32. Type, range and ratings of instruments and accessories for standards, power and electronics labs are discussed. Daystrom, Incorporated, Weston Instruments Div

131 **Capacitor** selection guide is a handy 6-p folder, GED-3687. Tables cover standard motors, 220 to 4000 v, 2 to 500 hp. General Electric Company

132 **High-voltage test sets** are covered in a series of catalog data sheets. Peschel Electronics, Inc

133 **Dielectric test set** makes stop-voltage-current, voltage-withstand and breakdown tests—4-p bulletin 22-5 gives details. James G Biddle Co

134 **Acetate electrical tapes** are detailed in booklet E-PABF. Charts list temperature limits; solvent, moisture resistance. Minnesota Mining and Manufacturing Co

135 **Welding electrical connections** to copper and steel is subject of 4-p bulletin. Method is applicable to splice, tap and grounding connections. Burndy Corporation

136 **Dc contactors** are outlined in 2-p spec sheet 1954. Ward Leonard Electric Co

INSTRUMENTATION

137 **Recorders** and recording controllers for measurement of electrical and process variables are described in 12-p bulletin GEA-6887. Product photos, application data, specs and schematics are included in this booklet. General Electric Company

138 **Feedwater-control system** is topic of 8-p bulletin 530. Installation photos, charts, diagrams give details. Bailey Meter Company

139 **Small-computer** installation and uses are discussed in 8-p paper S-509. Royal McBee Corporation

140 **Hand tachometers** are discussed in 4-p catalog 61. Product and application photos are included. Jones Motorola Corporation

141 **Purge rotameters** for indicating and manually controlling small flows are topic of 4-p bulletin 18P. Schutte and Koerting Company, Instrument Div

142 **Multipoint indicators** are illustrated in 4-p product specification P11-1. Bailey Meter Company

143 **Thermostat** for restricted-space applications is topic of 1-p bulletin 121. Burling Instrument Co, Inc

144 **Specific-gravity indicator** is covered in 2-p data sheet 188. Construction details, drawings are presented. Schutte and Koerting Company

145 **Selector switch** to direct or stop flow of compressed air to pneumatic actuators is topic of 2-p bulletin 357-2. The Powers Regulator Company

146 **Unitized annunciators** with completely enclosed relay plug-in units are subject of 2-p spec sheet 440LPG. Tigerman Engineering Company

WELDING

147 **Welding aluminum** is topic of 120-p comprehensive survey ADI 1258. Weldability data, defini-

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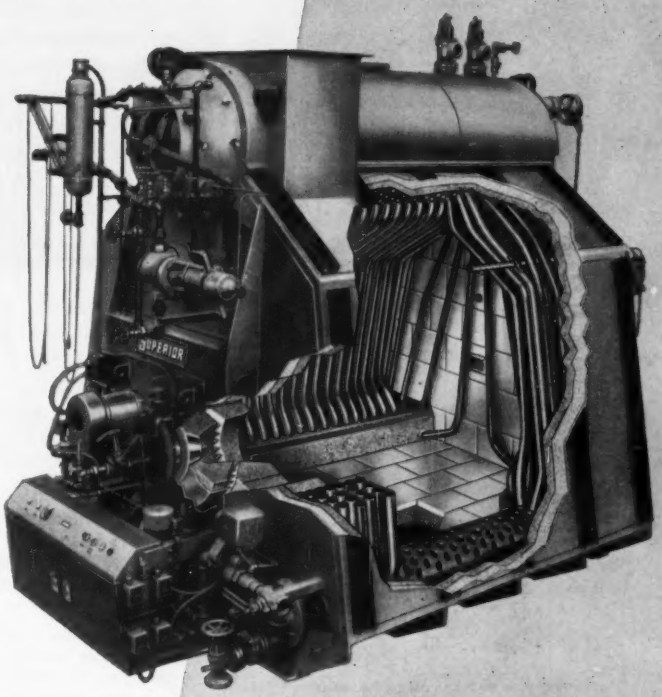

Specially designed for capacities not previously available to industry, the Superior Type A-S Boiler brings power plant, water-tube boiler performance for these capacities in a way that no shortened version of a large boiler could hope to do. The Type A-S has a properly proportioned furnace, with sufficient depth in relation to height and width to provide for correct flame propagation without impingement.

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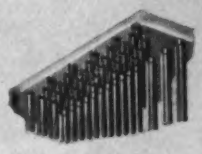
See the large, properly proportioned furnace which provides proper ratio of radiant surface to refractory for efficient combustion and maximum safe burner operating range.



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Tangent tube water wall furnace, promotes rapid circulation, fast steaming and eliminates maintenance necessary where refractory type baffles are used. All furnace wall tubes are riser elements discharging directly into the main steam drum.

Fully packaged, and backed by undivided responsibility, the Type A-S may be supplied for operation with either oil or gas. Write today for bulletin 11S.

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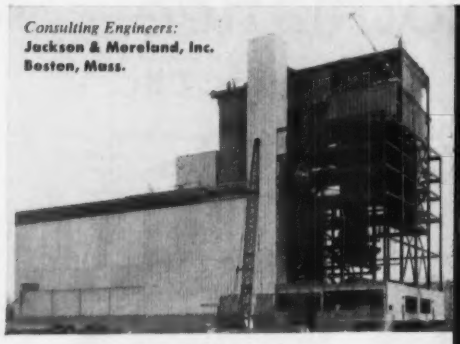

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Mt. Tom Power Plant
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B·I·F *Builders-Providence*

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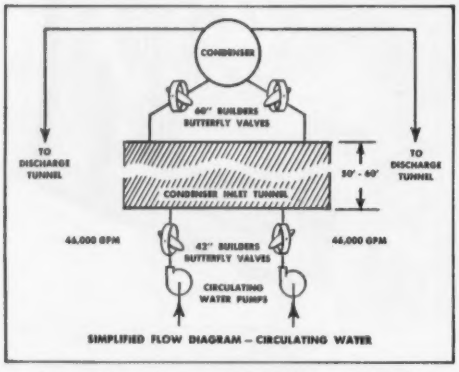
Mt. Tom Power Plant — Unit No. 1 is designed to provide 137,500 KW capacity with maximum efficiency.

Another modern power plant to benefit from quality features of Builders Butterfly Valves!

Four Builders Butterfly Valves selected for Mt. Tom Condenser Circulating Water System —

- **Two 42" Builders Butterfly Valves to be used as "autocheck" on pump discharge to eliminate water hammer and reverse flow.**
- **Two 60" Builders Butterfly Valves to be used for controlling up to 100,000 GPM of cooling water for condensing hundreds of thousands of pounds per hour of steam at turbine exhaust.**



Two 60" and two 42" Builders Butterfly Valves assure positive flow control in 92,000 GPM circulating water system.

Electric operators on the Builders valves add to ease of operation — offer provision for manual control.

Builders Butterfly Valves have been performance-proved in thousands of installations — in 4" to 120" sizes at pressures up to 125 psi —

- **Bubble-tight shut-off due to unique seat and bonding eliminates all leakage!**
- **Space-saving design permits compact piping layouts, cuts installation costs!**
- **Easy, trouble-free operation assures reliable, instantaneous flow control!**

REQUEST COMPLETE DATA! Free Bulletin 650-R2 fully describes design features. Write **B-I-F Industries, Inc., Industrial Sales, 354 Harris Ave., Providence 1, R. I.**

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B-I-F INDUSTRIES

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA

Free literature

Begins on page 110

tions and technical discussions of two processes, descriptions of equipment and power supplies are included. Air Reduction Sales Company

148 **Small-pipe welding** is topic of 12-p reprint ADR 118. Techniques and system designing are discussed in this booklet. Air Reduction Sales Company

MAINTENANCE

149 **Industrial floors** are discussed in 8-p booklet. Photos show latest methods of cleaning and care. Oakite Products, Inc

150 **Sound traps** to silence air-system and duct noises are described in 4-p bulletin. Koppers Company, Inc

151 **Fuel-oil sludge solvent** is subject of 4-p bulletin 594. Betz Laboratories, Inc

MECHANICAL POWER TRANSMISSION

152 **Power-transmission** machinery is reviewed in 8-p bulletin A-706. Fluid drives, couplings, V-belt drives are included. Dodge Manufacturing Corporation

153 **Timing belt drive** is covered in 4-p bulletin 20B8760. Units are available in five belt pitches. Allis-Chalmers Manufacturing Company

154 **Extra-light ball bearings** are outlined in 4-p bulletin 108. Tables give capacity, interchangeability data. Hoover Ball and Bearing Company

155 **Roller bearings** are explained in catalog PL-559. Specs, features, sizes and application data are given on nine models. Rollway Bearing Company

156 **Adjustable sheaves** in 2, 3 and 4-groove models are topic of 2-p data sheet 20B9125. Allis-Chalmers Manufacturing Company

STEAM GENERATION

157 **Refractory cements** to keep down maintenance costs in industrial furnaces are topic of 16-p booklet. Application photos, drawings, tables give details on expanded product line. Mexico Refractories Company

158 **Chrome-base refractory** material is covered in 2-p data sheet R-48. The Babcock & Wilcox Company

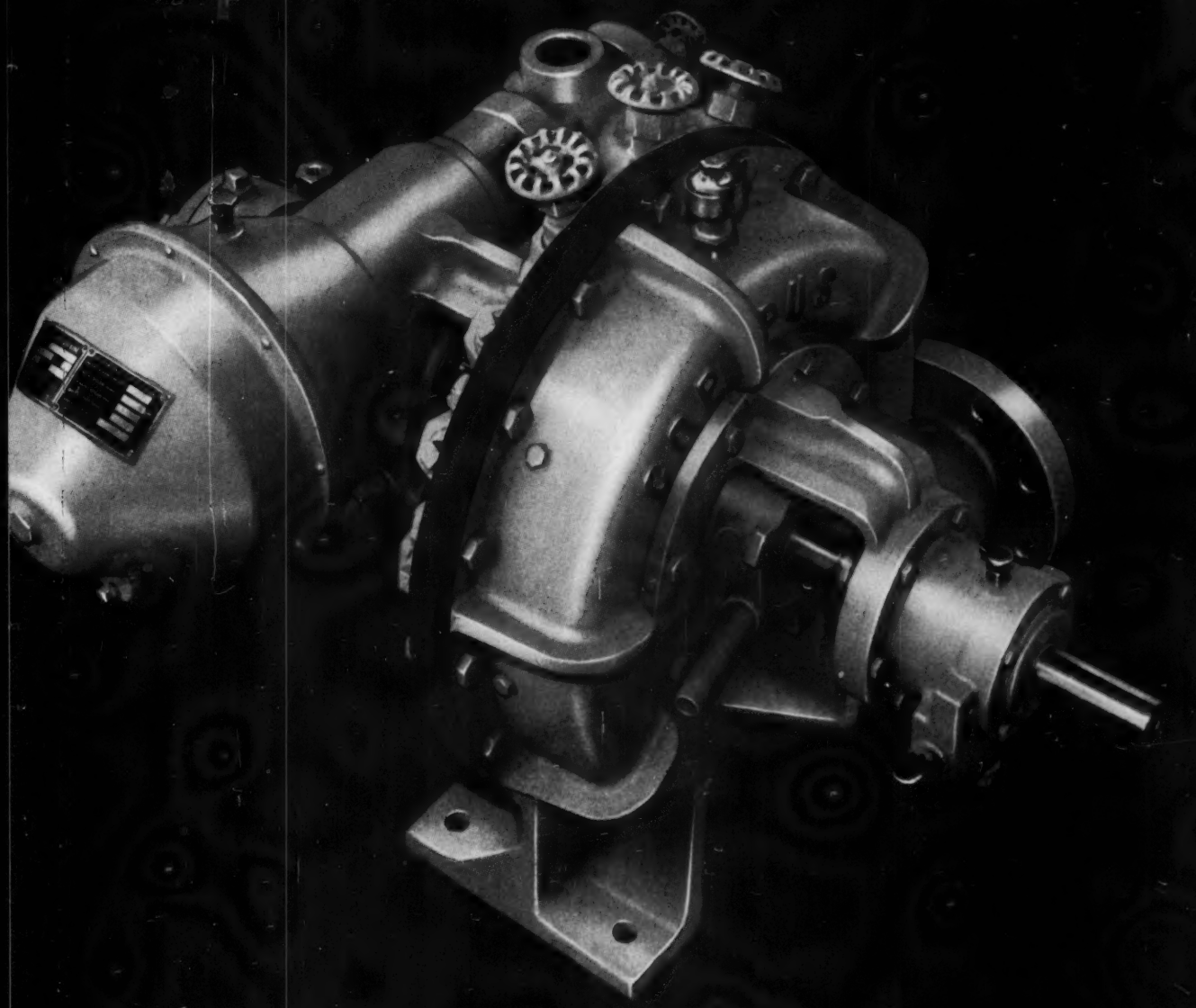
159 **Perforated metal** available for coal and aggregate screens is described in 6-p folder. National-Standard Company, Cross Perforated Metals Plant

continued

For more facts circle 249 on Reader Service card, p 97

circle 250 on Reader Service card, p 97 ➔

COPPUS BLUE RIBBON PRODUCTS



Coppus Horizontal Steam Turbine

NEW RUGGED DESIGN—BLUE RIBBON RELIABILITY!
Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 168 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

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PERFORMANCE-PROVED FOR 50 YEARS

American Rolling Ring Coal Crusher

In 1908 American Pulverizer patented the rolling ring principle of coal reduction. Today there are thousands of American Coal Crushers in operation ranging in size from Sample Crushers to Crushers having a capacity of 800 tons per hour.

American manufactures reduction equipment exclusively, backed by a half century of experience in the production of coal reduction equipment. Although improvements have been consistently made in American Crushers, the rolling ring principle still remains the most efficient method of coal reduction. This fact is **performance-proved** by hundreds of "cost of operations" reports from customers of American Rolling Ring Coal Crushers. May we have our engineers analyze your reduction problem?

Complete Literature Available. State your tonnage requirements.

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1349 MACKLIND AVE. SAINT LOUIS 10, MO.

Free literature

Begins on page 98

VALVES, PIPING, FITTINGS AND SPECIALTIES

160 **Process control valves,** pneumatic, electric, hydraulic and manual, are studied in 88-p catalog C800-1. Drawings, cross sections and comprehensive tables give details; one section covers reference data. Minneapolis-Honeywell Regulator Company, Valve Div

161 **Diaphragm control valves** are discussed in 8-p bulletin J-170. Cutaways, dimensional drawings, flow-capacity and rating charts cover sliding-gate and plate units. OPW-Jordan

162 **Butterfly valves** are described in 8-p bulletin 583. Table gives allowable pressure drop for seven classes. W S Rockwell Company

163 **Gate valves** designed for ductile iron are subject of 8-p brochure 1010. Specs, pressure-temperature ratings, dimensional and material charts are included. The Ohio Injector Company

164 **Check valves** in iron, bronze and steel are listed in 2-p circular 588. Lunkenheimer Co

165 **Pilot-operated valves** featuring rapid cycling are covered in 2-p data sheet 359. General Gas Light Co, Humphrey Products Div

166 **Manual control valves** are outlined in 2-p data sheet. Conoflow Corporation

167 **Fluid-mixing eductors,** regulating type, are explained in 2-p data sheet 2M-S. Schutte and Koerting Company

168 **Universal steam traps** are detailed in 16-p bulletin 800. Drawings illustrate operation, features; capacity charts and a steam-pipe selection nomograph are included. Perfecting Service Company

169 **All-purpose rotary union** is studied in 16-p bulletin 700. Installation drawings, cutaways, exploded views give details. Perfecting Service Company

170 **Pipe and block insulation** made of expanded silica is topic of 4-p data sheet. The Philip Carey Mfg Company, Industrial Insulation Div

171 **Light-wall fittings** and flanges made of stainless steel for noncritical process piping are described in 6-p bulletin. Chemetron Corporation, Tube Turns Div

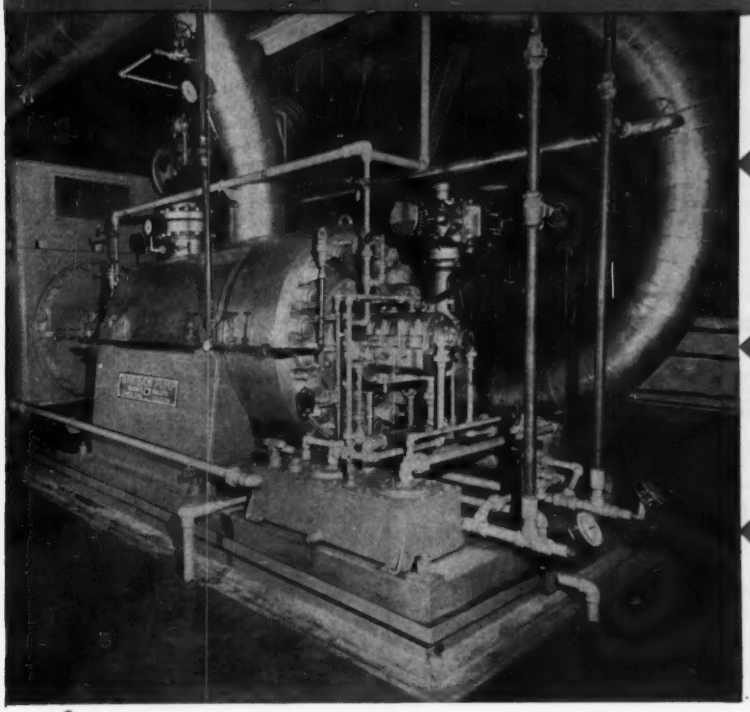
172 **Hydraulic packings,** homogeneous and fabric-reinforced types,

For more facts circle 251 on Reader Service card, p 97

Bingham

"DOUBLE VOLUTE" BARREL TYPE BOILER FEED PUMPS

THE ULTIMATE IN DEPENDABILITY FOR HIGH PRESSURE SERVICE



BINGHAM BARREL TYPE HIGH PRESSURE BOILER FEED PUMPS

PACIFIC POWER AND LIGHT COMPANY
Glenrock, Wyoming

ENGINEERS AND BUILDERS
Ebasco Services, Inc.

Bingham Barrel Type Boiler Feed Pumps, installed in the Pacific Power & Light Company plant at Glenrock, Wyoming. Each pump is designed to deliver 1875 GPM at 2300 PSI, operating at 3560 RPM.

Bingham "Double Volute" Barrel Type Boiler Feed Pumps are furnished with forged outer barrel for high pressure service. Pumps of this type are available for a wide range of capacities and heads. Your nearest *Bingham* office will be glad to give you full details on request.

BINGHAM BARREL TYPE BOILER FEED PUMPS feature:

- "Double Volute" construction.
- Double suction first stage for low NPSH.
- Balanced axial thrust (no balancing drums needed).
- Kingsbury Thrust Bearings.
- Stuffingboxes are arranged for either packing or mechanical seals.
- Stuffingboxes are subjected to suction pressure only.
- Designed for high operating speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Avenue, Portland 10, Oregon
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For more facts circle 252 on Reader Service card, p 97

In one package you get complete instrumentation, automatic after-cooling and sample cooling, automatic timed pressure flush to maintain high recovery efficiency, individual volume control valves, (with illuminated sight flow indicators), heat exchanger and flash tank. Matching cabinet sink is final touch. All interconnecting piping and wiring are installed. Only service connections need be made.

Ready-to-install Packaged Console for Continuous Boiler Blowdown and Recovery Handles all Functions Automatically

Saves Engineering Time, Saves Installation Time; Gives Maximum Thermal Recovery. It Does Not Forget, Mis-time, "Overshoot" or "Undershoot"

Schaub's continuous boiler blowdown and sampling system helps produce significant boiler room savings. With each operation performed exactly as it should be, when it should be, with no water lost in overflushing or overcooling, reduced costs can be anticipated. Thermal recovery is constant and at a high level. Mantime requirements are less. Space requirements are reduced. This Schaub Automatic Console System needs only field service connections to put it into full operation. Several man-weeks of design time, plumbing, steam fitting and wiring are eliminated.

For those boiler rooms where the fully automatic operation, complete instrumentation and cabinet design of the Schaub Console system may not be desired, Schaub can provide a ready-to-install "basic" system which provides all the functions of continuous blowdown, but under manual control.

Two, three or four boilers can be handled; either 250 pound or 600 pounds WSP. Capacities to 6000 lbs./hr. total blowdown. To learn further details on Schaub Systems for continuous Boiler Blowdown, mail the coupon below.

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Free literature

Begins on page 98

are detailed in 16-p bulletin P-333. Design, construction, sizes, applications, installation, service and temperature factors are covered. Crane Packing Company

173 **Water-treating equipment** is listed in 24-p booklet 615. Manual and automatic zeolite water softeners, domineralizers and deionizers, dealkalizers, deaerating heaters and chemicals are included. Elgin Softener Corp

174 **Multiple-bed** water conditioners are covered in 4-p brochure. Water Refining Company, Inc

175 **Condensate-control** system is explained in brochure 6001-B. Includes case histories. Cochrane Corporation

176 **Water treatment** in central air-conditioning system is discussed in 2-p bulletin AQ59. Water Service Laboratories, Inc

★ EDITOR'S NOTE: *The following bulletins may be requested directly from manufacturer. Write on company letterhead to addresses below*

★ **Facilities** brochure describes firm's manufacturing plants and equipment—power plant, pump, marine and nuclear-components divisions are covered. C H Wheeler Manufacturing Company, 19th & Lehigh Ave, Philadelphia 32, Pa.

★ **Cams, camshafts** and crankshafts are covered in 12-p bulletin 39. Applications, basic metallurgy and engineering properties are covered. Meehanite Metal Corporation, 714 North Ave, New Rochelle, N. Y.

Hydro station in Red China will use melted snow from Kunlun Mountains, 13,200 to 16,500 ft above sea level. Projected capacity is 12,000 kw.

Oil consumption in Britain increased 25% last year. About 31 million tons were used—10.6 million by industry.

AIEE has half as many organizational units as U.S. Government, but is a "do-it-yourself" organization, operated almost entirely by members, says president L F Hickernell.

New switch that can by-pass a voltage regulator in an electrical substation to permit maintenance without service interruption of other equipment was described to the AIEE.

YARDSTICKS FOR GASKET PERFORMANCE

The No. 1 reason for specifying Flexitallic Spiral-Wound Gaskets is predictable performance. The compression characteristics of each Flexitallic Gasket are always related to the pressure/temperature ratings of the flange. They are made for each other.

But, beyond this, engineers know that Flexitallic Spiral-Wound Gaskets give important advantages such as:

- Wet or dry, there is no change in the compression characteristics of a Flexitallic Spiral-Wound Gasket.
- In Style CG Flexitallic Gaskets, the standard ring completely seals the flange with steel, and gives positive indication of effective bolt load.
- The Flexitallic Spiral-Wound construction gives the safest possible seal for flammable or toxic fluids.

Flexitallic Blue, the blue-dyed Canadian asbestos filler, identifies the original Spiral-Wound Gasket construction.

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SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestoes filler.

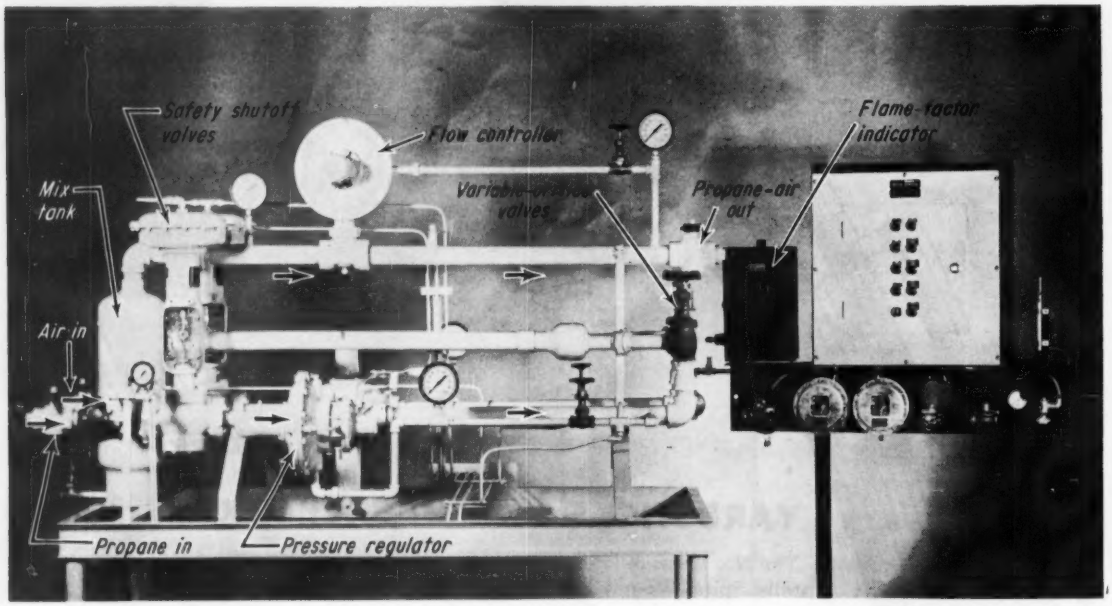
For more facts circle 254 on Reader Service card, p 97

EXCLUSIVE

Equipment design of the month

On this page each month you will see the wraps taken off a significant new product at least 30 days before it's released to any other publication, and before it's advertised anywhere

By STEVE ELONKA
Associate Editor



Now, a propane-air peak-shaving mixing unit

Completely new and simple propane-air mixing unit for industrial standby and municipal service is announced by the Applied Engineering Co.

This mixing system is adjusted manually to the desired Btu content. Once adjusted, flows can be raised or lowered instantaneously, plant can be stopped or started, while Btu content remains constant. Control systems actuated by calorimeter, caloropter, ratio controllers or specific gravity are eliminated.

Novel feature of this unit is that it doesn't compress both the propane and air after they are mixed. This feature is claimed to cut cost of compression. Since equal pressure drops of propane and air across preset orifices are maintained, the ratios of propane to air remain the same at all rates, and response to load changes is practically instantaneous.

Operation is by pushbutton control. Packaged in sizes from 2000 to 2,000,000 cu ft per hr and in pressures to 200 psig, unit can be used for either full standby or peak shaving. Standby propane-air (due to cost of propane) usually proves economical only if oil or coal cannot be used as standby. So propane-air is invariably used only where a gaseous fuel is required for standby.

Because unit is comparatively simple and economical, additional industries can now take advantage of interruptible natural-gas rates instead of firm rates. In the past many of these industries hesitated to take advantage of this saving because of the complications and insecurity of having a mixing plant which was too complicated and inaccurate to depend on as standby unit.

Unit is guaranteed to give $\pm 1\%$ Btu variation within 30 seconds from startup, and within 10 seconds after load change. In other words, instantaneous load changes do not affect accuracy of unit, which is most important.

For additional information, circle No. 97 on Reader Service card, page 97

NOW—CRANE Lip-Seal Bonnet Valves in three accurately rated pressure classes

What are your specifications for small, high-pressure, steel power plant valves? These three classes of Crane Lip-Seal Bonnet Valves will meet them accurately—and give you many exclusive service features as well! They're available in globes, angles and lift-checks*—in the following ratings:

1500-Pound ASA—in carbon steel (WCB)

1570 psi, 1050 F (2500-Pound ASA)—in Crane No. 7 chrome-moly (WC6)

2520 psi, 1050 F—in Crane No. 7 chrome-moly (WC6)

...And each class complies with ASA standards**

The patented, durable and maintenance-saving features of Crane Lip-Seal Bonnet Valves make them worthy of your first choice for high-pressure services—on drips and drains, blowdown, boiler feed, and similar applications.

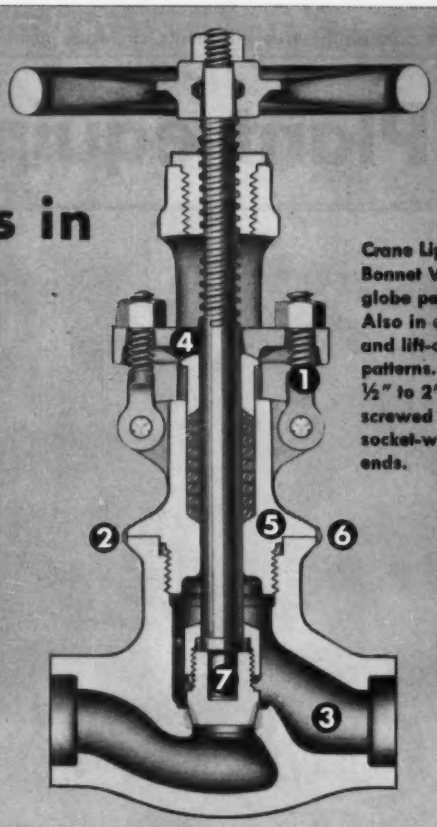
For complete details of structural and operational advantages of these valves, consult your Crane Representative or write to the address below.

****All Crane Lip-Seal Bonnet Valves are ASA-rated**

Minimum metal thicknesses comply fully with the requirements of ASA B16.5-1957, as well as ASA Code for Pressure Piping and ASME Boiler and Pressure Vessel Code.

*Check valves not available in 2520 psi rating.

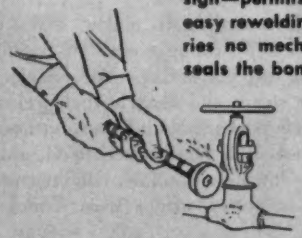
Write today for Crane Lip-Seal Bonnet Valve Bulletin AD-2373



Crane Lip-Seal Bonnet Valve, globe pattern. Also in angle and lift-check patterns. Sizes ½" to 2"; screwed and socket-welding ends.

TYPICAL QUALITY FEATURES

1. **Stainless steel eyebolts—prevent corrosion.**
2. **Welded bonnet joint—eliminates bonnet joint maintenance.**
3. **Compact design—with no sacrifice of strength, or size of port area.**
4. **Two-piece, ball-type packing gland—prevents binding on stem.**
5. **Body-centering lip—assures perfect body-bonnet alignment.**



6. Exclusive body-bonnet lip design—permits fast grind-off and easy rewelding. Lip-Seal weld carries no mechanical load—merely seals the bonnet joint.

7. Improved disc-stem connection—brings stem thrust closer to seating surface; assures positive closing, minimum vibration—without hampering swivel action of disc.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

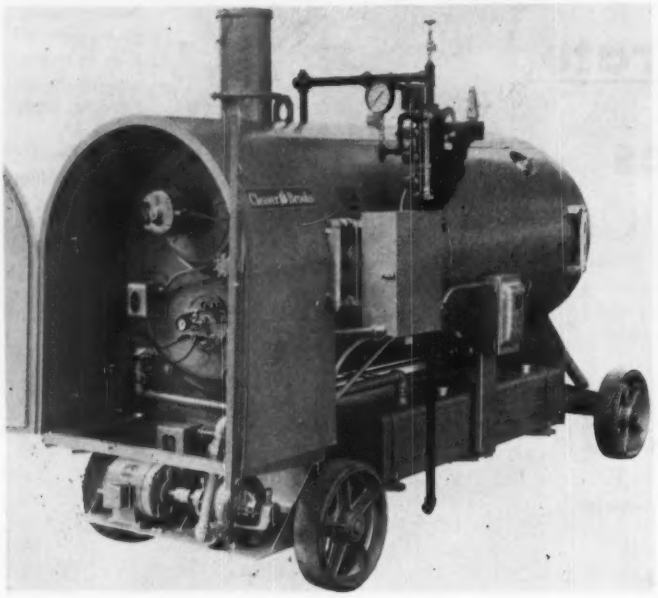
Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas

In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

For more facts circle 255 on Reader Service card, p 97

For more data on these developments, circle key numbers on Reader Service card, p 97

Plant equipment news . . . Your



Portable boiler generates steam where you want it

1 • Steam for cleaning and thawing is now produced where you need it by a compact portable boiler. Two models with outputs of 1380 and 1725 lb steam per hr at 212 F weigh about 5000 lb each. They measure 15x4x5½ ft, come mounted on a low carriage with hard-rubber tires for towing ease.

Attached makeup tank holds water for an hour's operation. A simple hose connection to local water supply will provide additional water for continuous operation.

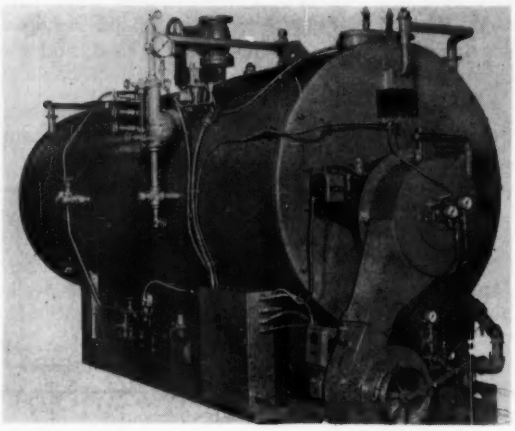
Units are fired with light oil. Each has an oil-storage tank holding 80 gal, enough for seven or eight hours. Rugged firetube boiler design is ideal for hard use, the maker states; tube surfaces are accessible for cleaning. "Weatherized" construction permits outdoor use.—Cleaver-Brooks Co.

Air-atomizing burners added to packaged-boiler line

2 • Low-pressure air-atomizing oil burners or ring type gas burners are features of revamped packaged boilers. Burners give stable, uniform flame patterns. They are said to burn all grades of oil or gas cleanly at extremely low noise levels. Modulating range is five to one.

First cost is lowered, according to maker, and smaller motors and preheaters cut operating costs. No. 4 oil can be burned with little or no preheating. For heavier oils, units have combination steam and electric fuel preheaters.

Model *AA* is a complete package, with boiler, burner, controls, refractory and insulation factory-assembled and fire-tested before shipment. It's now available in intermediate sizes, with larger units to come.—Ames Iron Works, Inc.



Greasing problems? Check these new lubrication developments

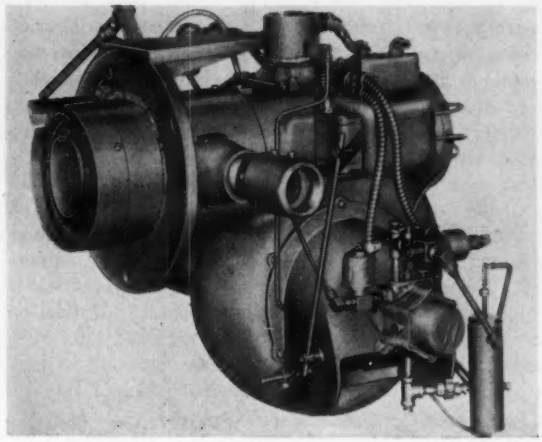
3 • Molybdenum disulfide additive for greases and heavy oils comes in dispersion form, to provide greater coverage with no increase in solids content. Predominantly finer particles in pre-wetted dispersion give 80% greater hiding power than powder, result in more coverage for your lubrication dollar, according to the manufacturer.

Another advantage of *'dag' 208* is uniformity. Easy handling, measuring and blending mean savings in time and labor.—Acheson Colloids Company

4 • Heavy-duty gear lube is available in SAE 90 and 140 grades. It's made from high-quality paraffin-base stock; designed for gear cases operating at excessive frictional temperatures, gears loaded beyond manufacturer's recommendations, cases where wear life is unsatisfactory.

Type *223X* is said to have good load-carrying ability through its entire range. Viscosity index is 100, flash point 390 F and fire point 420 F. You can pour it at 0 F.—The Alpha-Molykote Corporation.

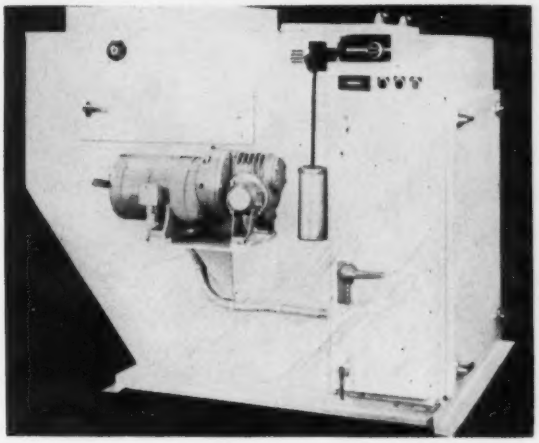
information center for new products and materials



Burners feature latest controls

5 • Latest types of electronic safety and operating controls are built into these inverted forced-draft pressure burners. Designed for application to Scotch marine boilers, the rugged, fully automatic units burn oil, gas and oil-gas combinations. Capacities range from 7 to 30 gph, 1,000,000 to 4,200,000 Btu per hr of gas.

Low-fire start system for oil is standard on larger sizes, optional on smaller ones. An extra limit control can be added for high-low fire operation. Full modulation is standard on larger gas burners.—Ray Oil Burner Co



Coal scale records continuously

6 • Belt-fed scale automatically weighs and records 15 tons per hr of coal or other bulk materials. It provides a continuous record of consumption accurate to 0.25%. Scale can be instantaneously set to bypass feed chute or to resume automatic operation.

The scale's dust-tight enclosure has 200-lb hopper capacity. Feed chutes, skirt plates, regulating plate and hopper are stainless steel for corrosion prevention. Unit is also available in portable models for making periodic checks on boiler efficiency.—Beaumont Birch Company

Make hi-pot and insulation tests with one instrument

7 • Combination unit tests electrical equipment at high voltages necessary to detect insulation weaknesses, shorts or grounds, and can indicate the presence of faults nondestructively. The instrument is engineered for fail-safe operation, so additional safety cabinets aren't needed.

Unit weighs 22 lb, measures 7x19x7 in. Standard units are rated 0- to 3500-v dc, 0- to 2500-v ac at 60 cps.

Large meters provide rapid, efficient readout, maker states. A fast-acting protective electronic circuit allows repetitive nondestructive tests. —Arizona Instrument Corporation

Automatic transfer switch has improved arc chute

8 • Positive protection of all main contacts is provided by NEMA Size 6 automatic transfer switch. Unit is electrically operated and mechanically held. It's rated for all loads to 600-v ac, 250-v dc. Continuous-duty current rating is 600 amp.

New transfer switch has dual-coil operating mechanism for positive action without need for delicate springs, latches or counterweights. One-direction stroke gives fast transfer from normal to emergency voltage. Switch has copper contacts with rolling and wiping action for longer contact life. —Zenith Electric Company

These ac power supplies can take 500% overload

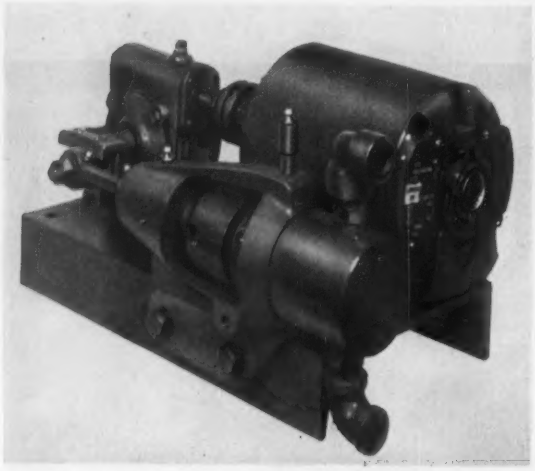
9 • Available in capacities from 0.1- to 100-kva continuous rating, power supplies can be overloaded as much as 500% for short periods. Low-voltage, high-current units are designed for field and lab testing in electric utilities and industrial plants.

Each power supply has a transformer providing a sinusoidal output voltage. Current is continuously variable from zero to maximum. The double-wound transformer has a variable-cross-section multi-tap secondary. Many combinations of output currents and potentials are possible, maker states.—Multi-Amp Corp

For more data on these developments, circle key numbers on Reader Service card, p 97

More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 97



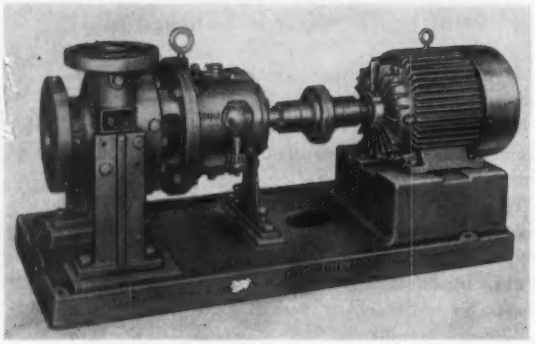
Low-cost pump meters most liquids

10 • Controlled-volume pump handles clear and corrosive liquids for chemical processes. Pump is job-engineered for metering situations demanding durability and accuracy—it's said to be rugged, highly economical.

In field and lab tests, model *CM* delivers maximum capacity of 28 gph in simplex design, double that in duplex design. It works at pressures up to 1100 psi.

Screwed gland packing gives flexibility. Materials available include steel and 316 stainless steel.

Simplified construction features plungers interchangeable within the pump frame, so that pumps can be converted from simplex to duplex in the field. The cartridge type column valves have double ball checks identical on suction and discharge ports. Stroke length, 1¼-in. maximum, is adjustable from 0 to 100%. Capacity is regulated by standard manual adjustment.—Milton Roy Co



New pumps fill process needs

11 • Hot-water circulation and all types of process applications are tackled by two new pumps. Enclosed-impeller centrifugal model *3775* pumps up to 850 gpm. It's a center-line mount unit with vertically split casing, water-cooled seal chamber and bearing housing. Back pull-out design promises easy maintenance. Maximum working temperature is 600 F, top pressure is 550 lb.

Model *3675* is close-coupled, also rated 850 gpm. Liquid end is bolted to flange-faced motor, rotating parts are assembled on motor-shaft extension. Limits for this unit are 275 F, 275 lb.—Goulds Pumps, Inc

Proportioning pump comes packaged ready for use

12 • Electrically driven, positive-displacement pump is designed for water treatment and process—wherever precise chemical feed is needed. Corrosion-resistant transparent plastic head, Hypalon diaphragm and check valves, straight-through flow design make unit efficient and compact for metering acids or alkalies.

Simplex model features adjustable wide-range proportioning up to 12 gph with discharge pressures to 125 psi. Complete package includes pump, suction and discharge tubing, injection nozzle, foot valve, tools and spare parts.—B-I-F Industries, Inc

Direct-operated reducing valve handles steam, air

13 • Direct-operated valve controls steam pressures for a variety of plant applications. Ports are sized and located to minimize falloff; an isolated diaphragm chamber gives maximum stability. Body passages are large and seating surfaces are lagged for tight shutoff. One model has a soft seat for air service.

Unit is lightweight, compact, easily installed and maintained, maker states. It's available in ½-, ¾- and 1-in. sizes in iron construction; reduced pressure ranges of 2 to 12, 8 to 50 and 25 to 150 psi.—Worthington Corporation, Mason-Neilan Div

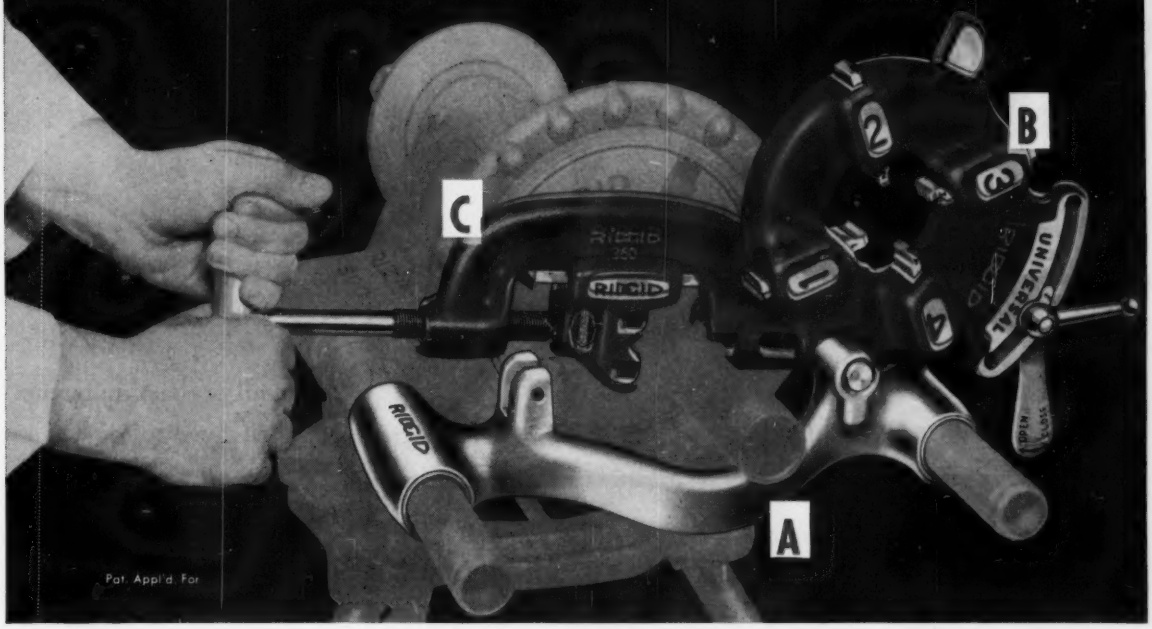
Bronze gate valve boasts quick and easy operation

14 • Redesigned valve provides tight shutoff against flow from either direction. A ball-and-socket joint between self-adjusting disk faces and accurate guiding are features that assure flexibility for pressure-tight seating, according to the manufacturer. A deep stuffing box seals operating stem but permits easy operation. Cap is bolted down with two screws to speed disassembly and reassembly.

Sizes from ½ to 4 in. are available. Units are rated 75-lb steam pressure for oil, water, gas. They're good for installations where quick operation is a must.—Lunkenheimer Co

For more data on these developments, circle key numbers on Reader Service card, p 97

Now!... Convert Your RIDGID 300 POWER DRIVE to a fast, smooth, low-cost pipe and bolt threading machine!



"3 Efficient, New RIDGID Accessories Save Me Time on Every Job!"

A **RIDGID No. 310 Carriage** — Slip this strong, lightweight aluminum alloy carriage on the support arms of your RIDGID 300 Power Drive, and you'll get real cut-and-thread efficiency! Holds die head and cutter at your fingertips exactly like a pipe machine. No fumbling for right size threader . . . no tools to drop. Easy sliding . . . snugs right up to chuck for close threading and cut-off.

B **RIDGID Die Heads** — The time-saving RIDGID 535 Quick-Opening Die Head shown here, or any other RIDGID Machine Pipe and Bolt Die Head, snap-locks into carriage quickly, easily... eliminates slow back-off. Single adjustment on carriage centers die head exactly for true threads every time.

C **RIDGID No. 360 Cutter** — Full-floating, wheel-type cutter... wide rolls for straight cuts at pipe machine speed. Attaches easily with swivel drive pin. Fits 310 carriage only.

Die head and cutter operate independently . . . swing up and stay out of way when not in use. Add a RIDGID No. 19 Nipple Chuck and you can thread close nipples.

For a bargain in fast, easy work, equip your RIDGID 300 Power Drive with these accessories ... available individually... at your Supply House!

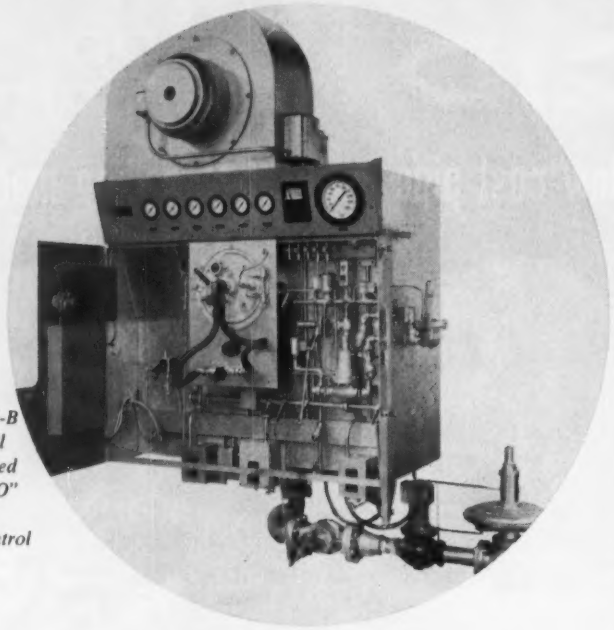
RIDGID

The Ridge Tool Company • Elyria, Ohio, U.S.A.

For more facts circle 256 on Reader Service card, p 97

"VO"

Coen "variable orifice" metering control . . .



Coen Model 56-B Fyr-Compak oil and gas packaged burner with "VO" full metering combustion control

. . . new optional feature with Fyr-Compak®

For those who want the advantages of metering without sacrifice of firing range, Coen now offers "VO" wide-range metering control. When used with the Coen Fyr-Compak packaged burner, an 8 to 1 *practicable* firing range is guaranteed with oil, 10 to 1 with gas. In this advanced design you get:

- True *full* metering, electric or pneumatic-electric
- Instant, accurate metering of both fuel and air in a single system
- Air flow controller sensitivity to .003″ w.c.
- Both fuel metering and precise matching of fuel to air flow provided by Coen "AC" valves
- Compactness through component packaging concept
- Lowest initial cost of any nearly comparable system
- Lowest installed cost due to packaging with burner

Fyr-Compak is a completely self-contained combustion unit specifically engineered for package boiler firing. With "VO" metering, its performance is maintained at an unequalled efficiency level through years of trouble-free service. Be sure to consider Fyr-Compak for your application... it's the finest packaged burner any boiler can have.

Combustion Engineers and Manufacturers

SINCE 1912 COEN

COEN COMPANY

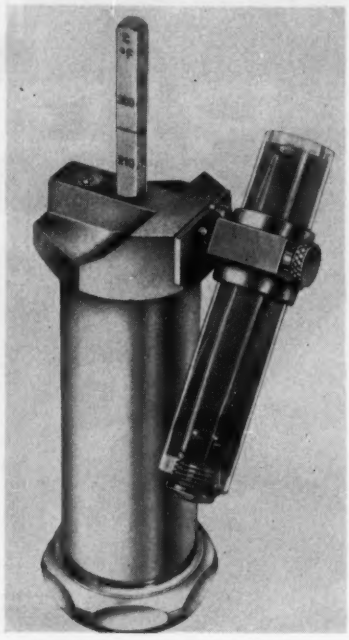
40 Boardman Place • San Francisco 3

FYR-COMPAK® GAS AND OIL BURNERS; FYR-MONITOR® FLAME SAFEGUARD SYSTEMS
FUEL OIL PUMPING, HEATING & STRAINING SETS; AIR HEATERS; KILN BURNERS

Representatives in principal cities throughout the world

Equipment news

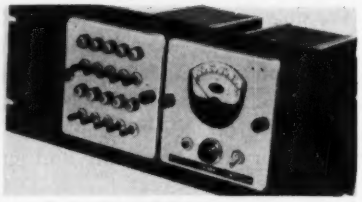
Begins on page 110



Fuel-oil preheat indicator

39 • Unit directly indicates temperature to which No. 6 fuel oil must be preheated for best atomization viscosity. Operation is entirely mechanical, so that an inexperienced man can use the indicator. A stainless steel cylinder holds oil sample, has a steel scale rod with piston at lower end fitted into it and a falling-ball timer attached. Preheat temperature is read directly on scale, with different scales available for various types of industrial burners.—Bacharach Industrial Instrument Co

Just circle key numbers on the Reader Service card, page 97, to get complete product story



Temperature monitoring

24 • System represents an extensive application of thermistor sensing devices in temperature instrumentation. Continuous monitoring system signals when temperature at any protected point reaches preselected high

You can't buy any other tower with the

SERVICE LIFE OF A MARLEY CLASS 600 DOUBLE-FLOW

Years . . . many more years than those now considered usual service life of cooling towers . . . are engineered into every Marley Class 600 Cross-Flow. Years of full performance; years of low maintenance; years for longer amortization. By incorporating (after comprehensive research) modern inert materials and protective processes throughout Class 600 design, Marley engineers have achieved an over-all durability that prolongs tower life expectancy beyond any current norm.

GLASS FIBER REINFORCED POLYESTER—steel-strong and impervious to corrosion—makes many components invulnerable to corrosion and decay; GRP molded **Fan Blades** are shatter-proof, shock resistant and completely unaffected by moisture or corrosive atmosphere. **GRP Fill Support Grids** position fill bars perfectly and permanently—no nails needed. **GRP Timber Connectors, GRP Retaining Rings** and **GRP Fan Cylinder Positioning** cannot corrode nor are they subject to oxidation that encourages decay in contacted lumber . . . they add vitality to critical areas, as do **Ceramic Timber Ring Connectors** and **Louver Supports** molded of rigid linear polyethylene.

ASBESTOS CEMENT BOARD—fire-safe and wear-proof—forms casing walls and wide, functional louvers that characterize Class 600's.

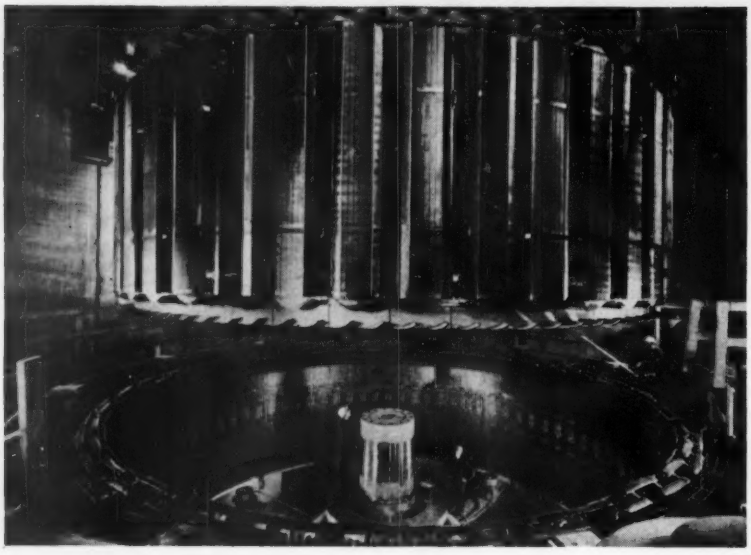
MARLITH PRESERVATIVE TREATMENT is life-insurance for tower lumber. Applied after fabrication, every piece of wood is deeply and thoroughly impregnated with toxic, proven protection against rot and decay.

MARLEY®

The Marley Company

For more facts circle 258 on Reader Service card, p 97

ASEA - A GREAT NAME IN POWER GENERATION TRANSMISSION DISTRIBUTION



For more than 75 years the name ASEA has been associated with important forward moves in the development of all phases of the power engineering field.

Photo shows one of the latest ASEA contributions to the power field . . . the largest water-turbine-driven generators in the world, installed at one of Sweden's biggest power stations at Stornorrfors. ASEA is supplying not only the generators for this station but practically all its electrical equipment including turbine regulators, transformers, switchgear, protective equipment, etc. As distinct from earlier manned power-stations, the Stornorrfors plant is equipped for automatic starting of power units.

We will be pleased to send you descriptive literature on any ASEA product in the power generation, transmission and distribution fields. Our American engineers will be pleased to assist you with your application problems. Call or write to:

ASEA

ASEA ELECTRIC INC.
500 Fifth Avenue, New York 36, N.Y.

Equipment news

Begins on page 110

or low. Applications include checking bearing temperatures in generators, turbines, pumps and other rotating equipment, protection for processes, pipelines. Temperatures of 125 to 600 F can be monitored.

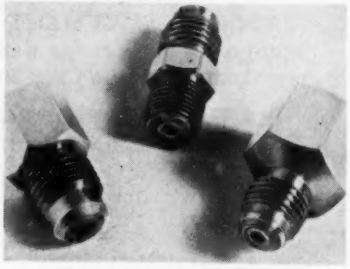
All points are monitored continuously and simultaneously, and no scanning devices are used.—Fenwal Incorporated

Just circle key numbers on the Reader Service card, page 97, to get complete product story

Compound leverage wrench

16 • Pressure applied on malleable handle of this wrench is multiplied by two. Adjustable hook jaw turns pipe in one direction while offset chain vise grips fitting and exerts equal pressure in opposite direction.

Unit tightens or loosens right- or left-hand threads. It comes in four sizes for 2- to 8-in. pipe.—The Ridge Tool Company

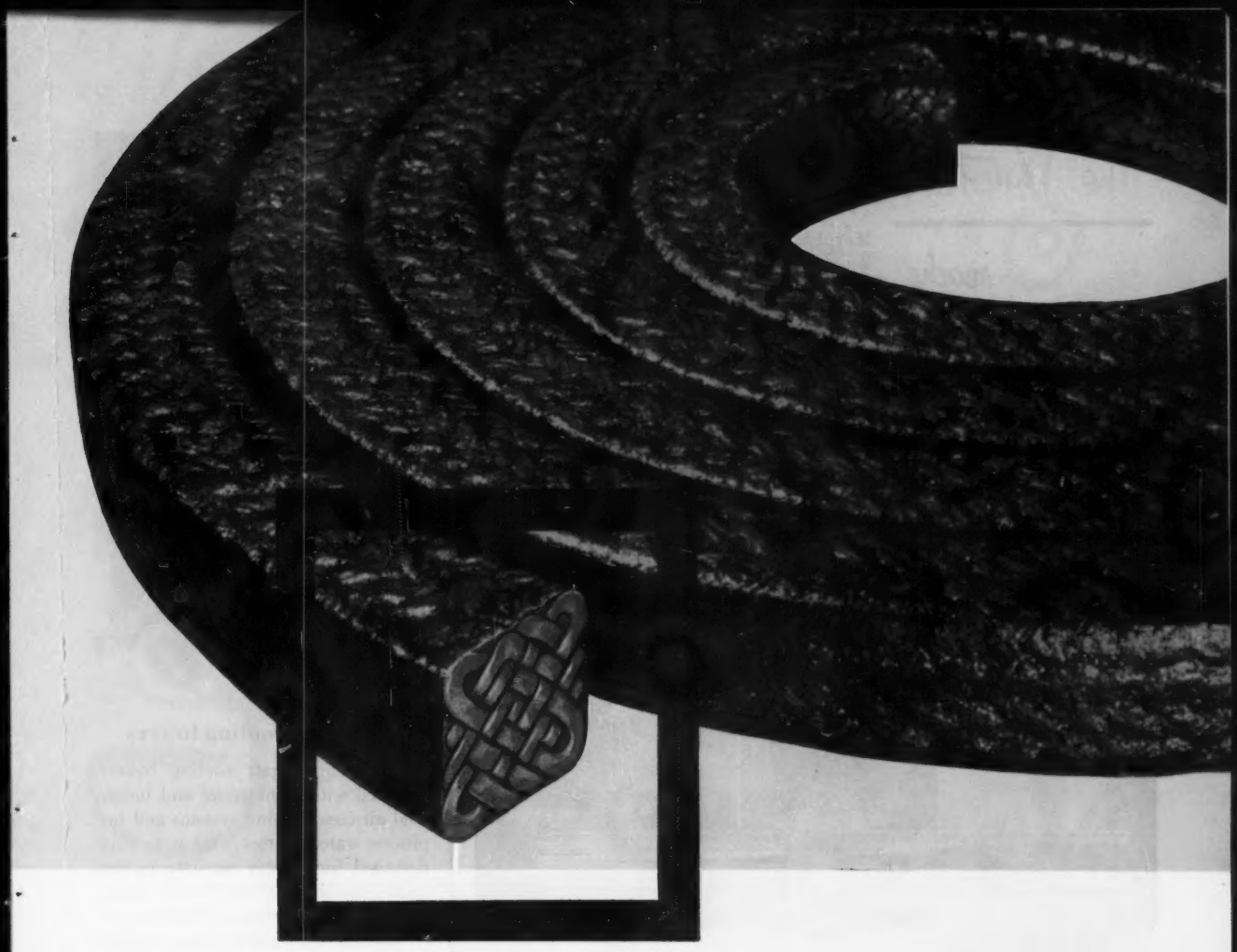


Pressure snubbers

41 • Compact, inexpensive units are designed for refrigeration and air-conditioning applications. Snubbers protect pressure-sensitive instruments against line-induced pulsations or surges. An added bonus: they help prevent refrigeration-system leakage since design eliminates a joint in con-

For more facts circle 259 on Reader Service card, p 97

circle 260 on Reader Service card, p 97



ANKORLOK . . . Braid Packing

FLEXIBLE! STOPS LEAKAGE! LONG LASTING!

Here is a superior braid packing fabricated from asbestos, flax, cotton, Anklon* that will not unravel, will not wear through, will not slough off! Ankorlok offers further advantages: it "locks in" the lubrication, is flexible without distortion in forming rings, and maintains the original lubricant so constant that the basic fibres of the packing are permanently preserved.

Suitable for either reciprocating or rotating service against steam, hot and cold water, alkalis and weak acids.

Note the construction at the cutaway end of the above illustration. For further details we invite your inquiry.

*Made of Teflon (E. I. duPont)

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BOSTON, MASS.	MONTREAL, CANADA
BUFFALO, N.Y.	NEW ORLEANS, LA.
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CINCINNATI, OHIO	NEW YORK, N.Y.
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THE ANCHOR PACKING COMPANY

GENERAL OFFICES . . . PHILADELPHIA, PENNSYLVANIA
FACTORIES . . . MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

● FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

the V-notch

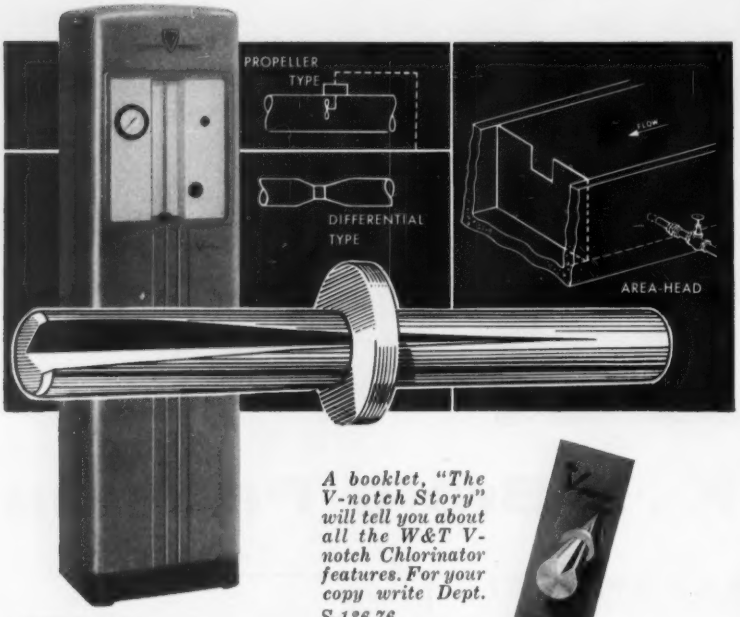
ready and waiting for your signal

Lots of jobs are done better automatically. Changing chlorine feed rate is now one of them. With the V-notch... the straight line metering action of the plug through the ring makes automation simple.

Merely by adding, not adapting, a W&T V-notch Chlorinator can give you any degree of automatic control you want—step rate, start-stop, program, proportional, even residual control.

With a V-notch Chlorinator any signal from any primary metering device can control chlorine feed. So anyone can afford automation.

And, of course, the right plastics make the whole chlorinator chlorine-proof.



A booklet, "The V-notch Story" will tell you about all the W&T V-notch Chlorinator features. For your copy write Dept. S-136.76.

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

W&T DRY CHEMICAL FEEDERS

For Accurate Feeding Of Water Treatment Chemicals

Full line of wide range dry chemical feeders capable of controlling a few ounces to 3000 lbs. per minute.

Write for Bulletin M-38 for complete Dry Feeder information.

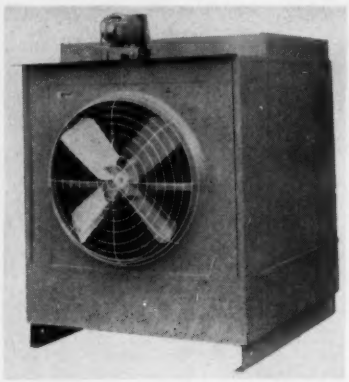
WALLACE & TIERNAN INCORPORATED
25 MAIN STREET. BELLEVILLE 9. NEW JERSEY

Equipment news

Begins on page 110

necting threaded devices to the tubing.

Snubber element is a ¼-in. disk containing fine pores, fabricated from Type 316 stainless steel to guard against free-acid corrosion.—Chemiquip Company

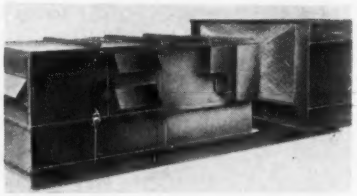


Packaged cooling towers

53 • Induced-draft cooling towers are used with commercial and industrial air-conditioning systems and for process water. Series *3200* units were designed for greater capacity in less space: model *3208* has 7.5-ton capacity at 78 F wb, measures 30x45x54 in.

All-steel with plastic base coating or stainless-steel units are available. Heart-grade redwood filling, stainless-steel fan shaft and Venturi type fan throat are standard equipment. —Mason Products, Inc

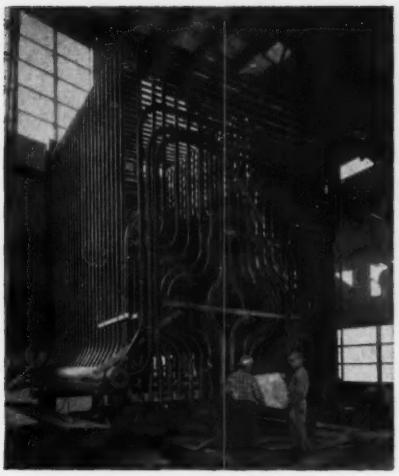
Just circle key numbers on the Reader Service card, page 97, to get complete product story

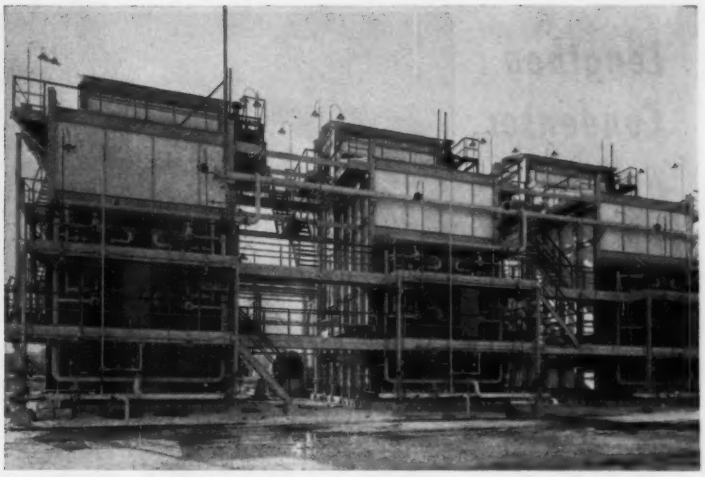


Rooftop air conditioners

40 • Packaged units offer top economy since they're installed with minimum engineering and labor on the roof of 1-story buildings. The air conditioners heat with gas, cool with electricity. They're built in two sizes: 200,000-Btu per hr input heating with 7½-hp cooling; 250,000-Btu heating with 10-hp cooling.

Package is factory assembled and





AT LEFT: Installing a 60,000 lbs/hr unit in a brewery

ABOVE: A battery of 125,000 lbs/hr units in a chemical plant

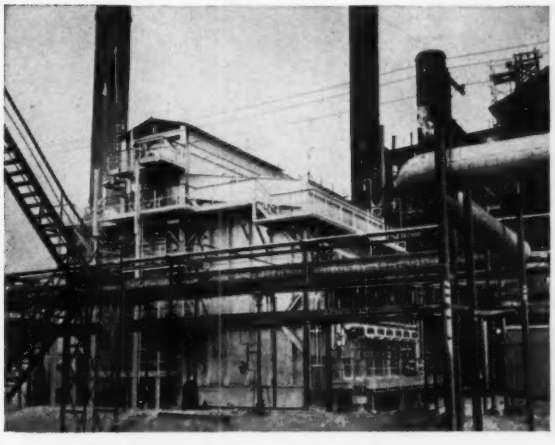
CUSTOM *Steam* GENERATORS

Vogt engineering advances can save you money if you have a steam generating problem. Custom-built installations shown, are engineered to assure efficient, dependable steam generation for power, process and heating. Our engineering staff is available to give effective help in the solution of steam generating problems peculiar to a wide variety of operating conditions. Address Dept. **24A-BP.**

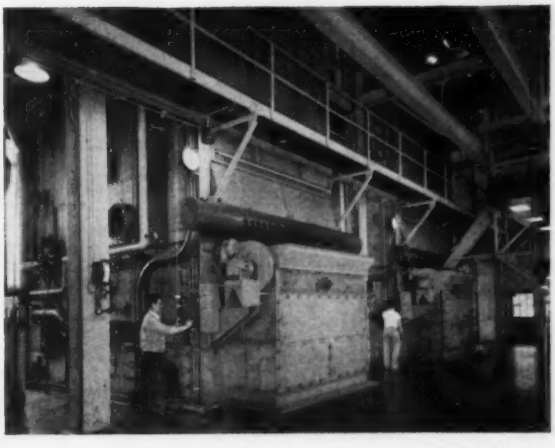
by Vogt

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati



This 400,000 lbs/hr unit is installed in a leading petroleum refinery



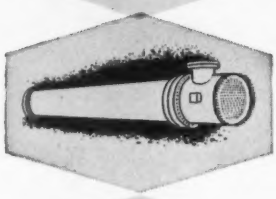
Three 40,000 lbs/hr units serve a medical center

For more facts circle 262 on Reader Service card, p 97

Lengthen Condenser and Heat Exchanger Life

John Crane®

Plastic* Tube Protectors

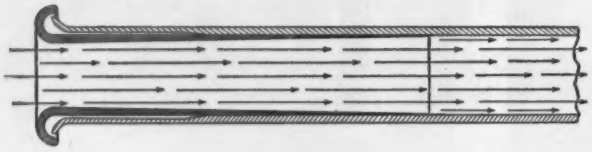


- Protect tube ends for life of tube.
- Positively prevent erosion and abrasion.
- Reduce costly tube maintenance and replacement.
- Easy to install—just slip into tube inlet after coating outer surface with cement.

* Nylon, Polyethylene or Phenolic Resin

PLUS EXCLUSIVE FREE-FLOW DESIGN

Wall thickness gradually tapers toward discharge end. Assures smoothest possible water flow, eliminates turbulence.



Get the facts. Request new Bulletin P-335.

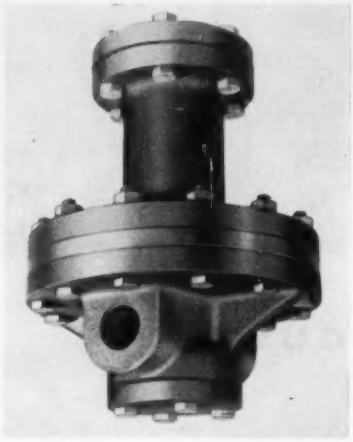
John Crane® CRANE PACKING COMPANY

6430 Oakton Street, Morton Grove, Illinois (*Chicago Suburb*)
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

Equipment news

Begins on page 110

wired; buyer just sets it over an opening in the ceiling, fits it to a diffuser. No ductwork needed, according to maker.—Carrier Corporation

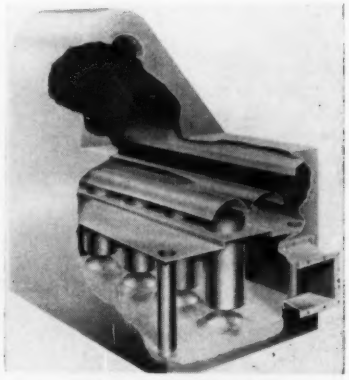


Steam-service regulators

48 • Differential - pressure regulators are available in two models, for control of atomizing steam pressure at an adjusted value higher, above, or lower than fuel-oil pressure.

Both types are available in ½- to 2-in. sizes. Minimum of moving parts, no internal adjustments are features. The regulators have shear-port design with a honed guide. Ports indicate rupture of steam or oil diaphragm.—Atlas Valve Company

Just circle key numbers on the Reader Service card, page 97, to get complete product story



Wet dust collector

25 • Hydrostatic concept of dust collection uses a circular venturi to introduce a mixture of dirty gas and water into a vertical cylinder. Cylin-

72 tons of *FLY ASH* collected a day!

GREEN'S AERODYNE HELPS SOLVE CONSOLIDATED EDISON'S FLY ASH PROBLEM

Installation of Aerodyne Units at Consolidated Edison's Hell Gate Electric Generating Station.

Green makes this AERODYNE mechanical dust collector, to collect fly ash and other dusts. Does this Green AERODYNE really work?

Well, let's quote a few words from Mr. J. J. Grob, Chief Performance Engineer, Mechanical Engineering Department, Consolidated Edison Company of New York, Inc.

QUOTE 1
Why used ..... "At Hell Gate Station two Aerodyne mechanical collectors were installed in the uptake flues of boilers No. 11 and 12 for removing the bulk of fly ash leaving the furnaces."

QUOTE 2
72 tons of fly ash per day ..... "The furnaces are slag tap and, of that ash which would otherwise be expelled to the electrostatic precipitators before entering the stack, the Aerodyne units, based on careful tests, remove approximately 72 tons of fly ash per day."

QUOTE 3
Satisfactory ..... "The operation of the Aerodyne mechanical collectors has been satisfactory and the life of the cones has greatly exceeded expectations."

We repeat, in all modesty — Green can help you solve FLY ASH and DUST collection problems.

Why not write and ask us?

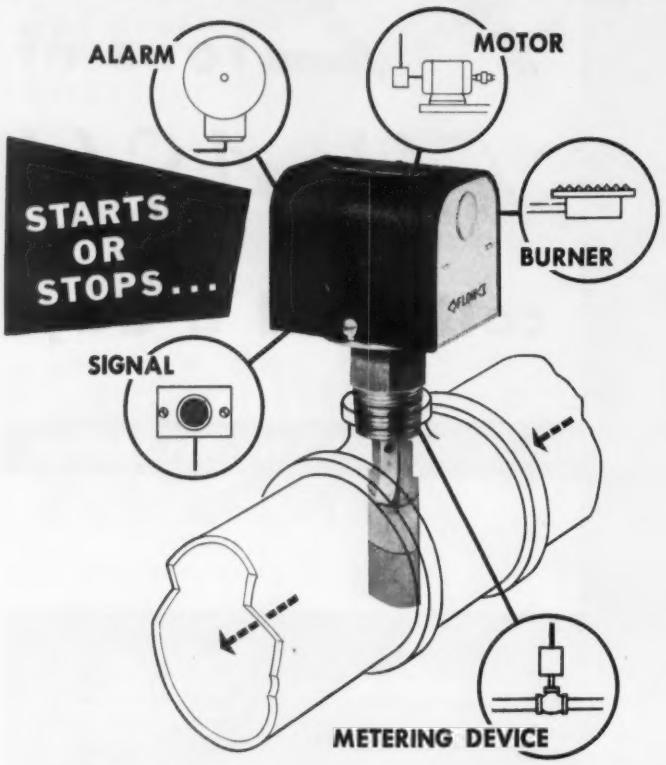
Green

THE GREEN FUEL ECONOMIZER CO., INC. **BEACON 3, NEW YORK**

For more facts circle 264 on Reader Service card, p 97

Makes or breaks a circuit when flow STARTS . . . or STOPS

McDonnell FS4 Series Flow Switch



The illustration tells the story of the McDonnell FS4 Flow Switch. Installed in a pipe line, it is a moderately priced, highly dependable device that makes or breaks a circuit when flowing liquid moves the paddle—to perform almost endless functions vital to safety and automatic operation. Underwriters' Listed.

New Bulletin FS-1 fully covers all details of construction and service ranges. Also contains typical applications that may suggest important services the FS4 Flow Switch can perform in your plant.

McDONNEL & MILLER, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

McDONNELL

Flow Switches

Boiler Water Feeders • Low Water Fuel Cut-Offs
Pump Controllers • Relief Valves • Related Liquid Controls for Tanks, Stills, Air Conditioning Systems

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Mail to: McDonnell & Miller, *Inc.*, 3506 N. Spaulding Ave., Chicago 18, Ill.

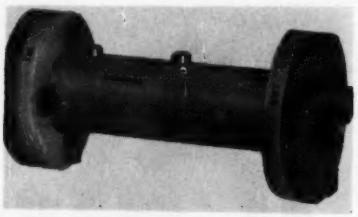
der keeps dusty air in cleaning element longer so water and dust particles have better chance to collide. Then water is removed from air stream by a circular baffle. Venturi variations let unit meet any wet-collection requirement, maker states.

Dust-disposal arrangements available include flat-bottom hoppers for manual cleaning, triangular hoppers for continuous flushing, chain and paddle scraper for flat-hopper sludge removal, separate settling hoppers to combine with other arrangements. Collector can handle floating material. —Fly Ash Arrestor Corporation

Just circle key numbers on the Reader Service card, page 97, to get complete product story

Engine starting control

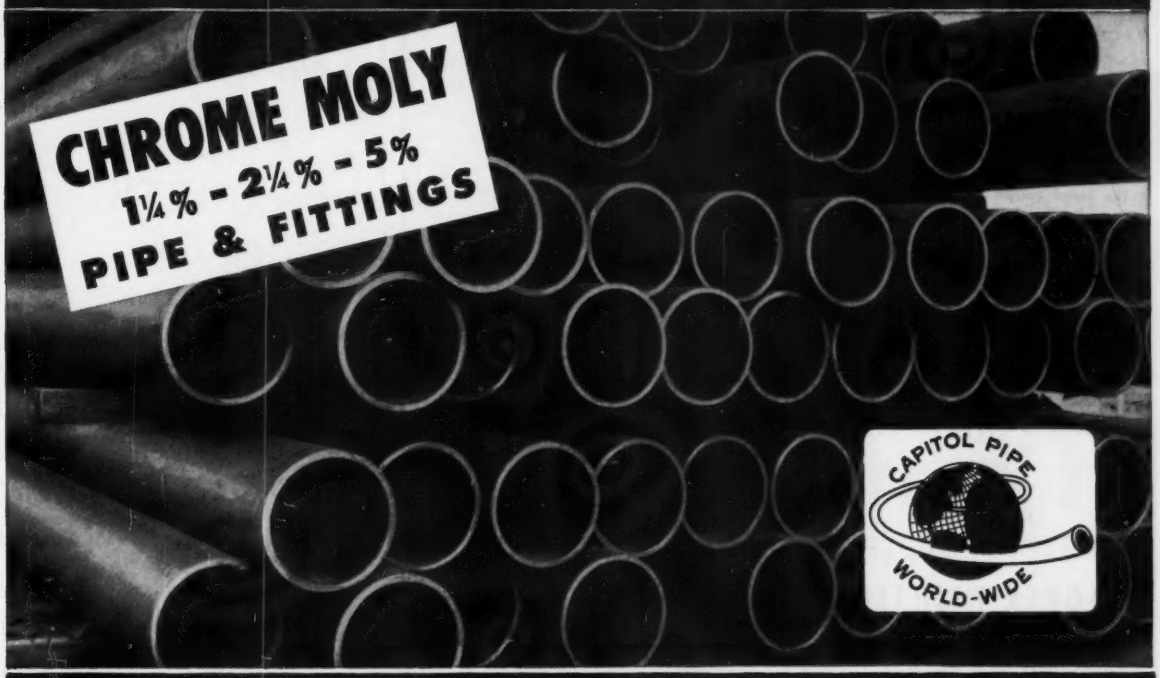
21 • This control is designed for fully automatic starting and stopping of engine-driven generating sets. It prevents recranking at full engine speed, responds at 50% of normal battery voltage, operates over a broad ambient temperature range, according to manufacturer. — Automatic Switch Co



Mass flowrate meter

38 • Primary element measures the mass rate of flow of gases, independent of pressure and temperature. Element is an annular orifice, with

OUR *NEWLY INCREASED* INVENTORY PROGRAM



. . . assures you of IMMEDIATE SHIPMENTS, rather than lengthy mill deliveries and over-runs

Our long *experience* with the piping problems and requirements of Refineries, Petrochemical Plants, and Power Plants—and our exceptionally close relationship with the Piping Fabricators, Engineers, and Contractors has enabled us to *design* and *plan* our *Inventory Program* to meet the current demands for high temperature chrome moly pipe and fittings. Products of U.S.A. "top brand" manufacturers are your assurance of highest quality . . . We sell at Mill Parity Prices . . . our deliveries are very prompt.

Whether you need a length of pipe or a carload, you can rely upon Capitol day-in and day-out.

Shown above: Partial bay of 2300 feet of 14" Sch. 80 Pipe A335 P11 carried in stock

WE CARRY LARGEST STOCK OF LOW AND INTERMEDIATE CHROME MOLY PIPE ½" THROUGH 20"; SEAMLESS WELDING FITTINGS 2" THROUGH 14" —AND FORGED ALLOY FITTINGS ¼" THROUGH 2".

Capitol

PIPE & STEEL PRODUCTS, INC.

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The latest edition of the **Equivalent Valve** manual, for Design Engineers, Purchasing Agents, and Valve Salesmen contains in one loose leaf book a complete list of available industrial valves of 28 leading manufacturers. Many valves listed were not shown in the previous editions. To keep pace with the latest changes revised pages are issued each year.

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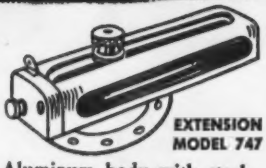
"ON-THE SPOT" EFFICIENCY

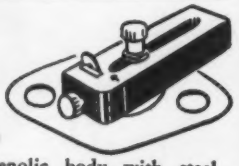
SPEARHEAD GASKET CUTTERS

HAND • TOOLS



EXTENSION MODEL 747

Aluminum body with steel blades and inch and metric scales. Cuts precision round gaskets any size



HANDY MODEL 750

Phenolic body with steel blades and inch and metric scales . . . cuts round gaskets ¼" to 6", odd shapes and straight pieces any size

ZIMMERMAN PACKING

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120 LIBERTY ST.
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CHICAGO 46, ILL.

Equipment news

Begins on page 110

area of orifice controlled by a sealed bellows unit. Length of bellows is determined by temperature and pressure of flowing gas. The element is available in stainless steel construction and with phosphor bronze or brass bellows for low pressures.—National Instrument Laboratories, Inc

Feedwater heater

31 • Internal vent condenser is feature of a new feedwater heater. A double-walled hood at heater's top has opposing fins on inside walls to slow, condense the rising steam. Air and noncondensable gases escape to atmosphere through air-vent valve.

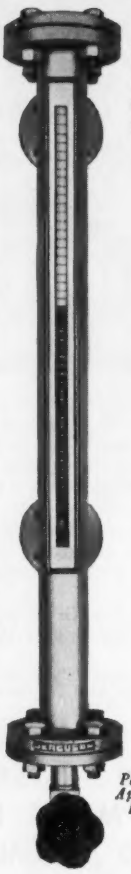
Flow of steam and water in opposite directions insures maximum feedwater temperature with low steam consumption, maker states. Vertical or horizontal storage section is available, and units range from 3000 to 300,000 lb per hr.—Stickle Steam Specialties Co

Just circle key numbers on the Reader Service card, page 97, to get complete product story

Giant expansion joint

20 • Rectangular expansion joint measures 21x28 ft. Designed to operate in condenser service, it takes external pressure of 14.7 psig. It accommodates 9/16-in. in compressed travel, ¼-in. in expanded travel with

Announcing
the New
Jerguson
MAGNETIC GAGE
For Liquid Levels



An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

Distinct, accurate level shown in red contrasted with silver above.

Job designed, correlating pressure, temperature, and specific gravity.

Available with electric alarms.

Patent Applied For

Can also be used for interface indication.

Write now for engineering sheet on Jerguson Magnetic Gages.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
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Offices in Major Cities
In Canada: Peacock Bros. Ltd.

circle 269 on Reader Service card, p 97

 circle 268 on Reader Service card, p 97

SHOP ASSEMBLED

in a single package

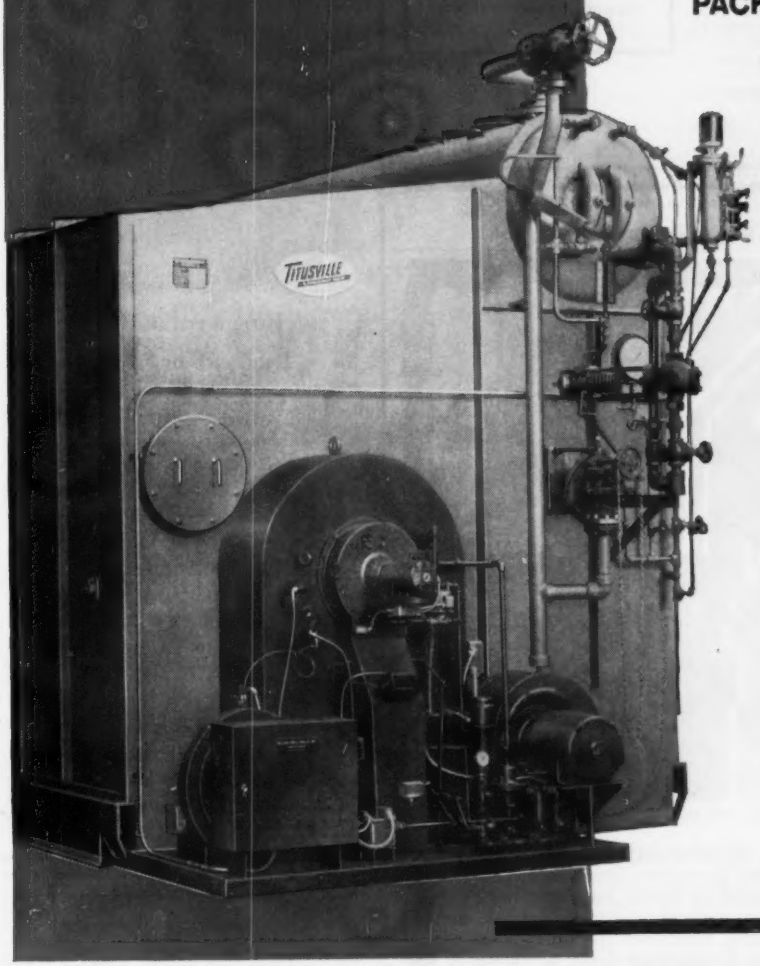
READY FOR SERVICE

as soon as connected

Versatile and efficient in operation

TITUSVILLE TYPE WTP

PACKAGE STEAM GENERATOR



This is the modern water-tube steam generator that is *packaged to serve you better*—easy to transport due to compact size, ready to operate soon as service-connected, and adapted for firing with heavy oil; combination heavy oil and gas; light oil; combination light oil and gas; natural gas; manufactured gas; and coke oven gas. The Titusville Type WTP requires no high stack or induced draft fan, is ruggedly automatic-welded throughout, meets latest ASME code requirements, and offers wide choice of full or semi-automatic control arrangements. Let a TITUSVILLE Engineer discuss your steam generator needs, soon!

Write for your copy of the latest Type WTP Steam Generator folder, plus complete specification data.

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THE TITUSVILLE IRON WORKS CO.

TITUSVILLE, PENNSYLVANIA

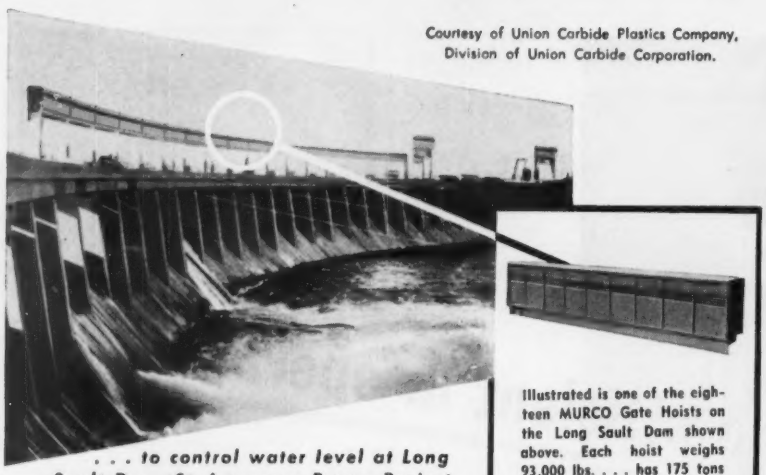
BOILER DIVISION: BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units. **PROCESSING EQUIPMENT DIVISION:** Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters. **FORGE DIVISION:** Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement

Plants at Titusville, Pa. and Warren, Pa.

Offices in Principal Cities

Courtesy of Union Carbide Plastics Company, Division of Union Carbide Corporation.



. . . to control water level at Long Sault Dam, St. Lawrence Power Project

MURCO GATE HOISTS

For the second largest hydroelectric power plant in the United States at Massena, New York—as part of the St. Lawrence power project—Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists to control the water level at Long Sault Dam. MURCO Gate Hoists are designed from knowledge and experience . . . backed by over 75 years in design and manufacture . . . made for any size power dam . . . capacities from less than 1 ton to over 100 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.

Illustrated is one of the eighteen MURCO Gate Hoists on the Long Sault Dam shown above. Each hoist weighs 93,000 lbs. . . . has 175 tons lifting capacity . . . will raise and lower the gates in the dam at a speed of 1 foot per minute. The overall length of each unit is 57 feet . . . 8½ feet wide and 12½ feet high. Write for complete information and Engineering Department recommendations.

Manufacturers Since 1883

MURCO

D. I. MURRAY MANUFACTURING CO.
WAUSAU, WISCONSIN

For more facts circle 271 on Reader Service card, p 97

Robertshaw's Vibraswitch Malfunction Detector
prevents costly machinery damage by actuating an alarm or shutting down machinery the instant excessive vibration occurs. Vibraswitch anticipates trouble caused by failing bearings, bent shafts, broken blades or overspeeding and can easily be installed on pumps and motors, cooling tower fans, compressors and blowers, gas and diesel engines, and turbines. For further detail write for Bulletin RF-586. **Aeronautical and Instrument Division, Robertshaw-Fulton Controls Company, Santa Ana Freeway at Euclid Avenue, Anaheim, California**

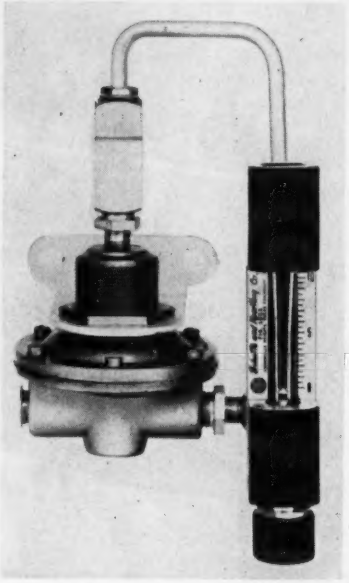
For more facts circle 272 on Reader Service card, p 97

Equipment news

Begins on page 110

±.032-in. lateral deflection at maximum temperature of 500 F, with 15-psig internal pressure.

First of the 5000-lb units has been installed at a utility plant. Joints are custom-built in eight to 12 weeks. —Temp Flex Company



Purge rotameters

33 • Rotameter line is designed to measure and control liquids flowing at a few gallons, gases at a few cu ft per hr. Stainless steel and other corrosion-resistant materials are used for standard models' fluid-correcting surfaces, and special models can be made with Kel-F or Lucite.

Interchangeable tubes and floats used in same body give nine capacity ranges, from 0.6-gph water, 0.5-scfh air at 10 psig to 12 gph water and 70-scfh air at 10 psig. Differential regulator maintains constant pressure differential across rotameter, producing a constant flow rate for any given setting of needle valve.—Schutte and Koerting Company

Just circle key numbers on the Reader Service card, page 97, to get complete product story

Amino-silane chemical

22 • Chemical reacts with organic and inorganic materials, unites them in a strong, durable bond. Z-6020 can be used to improve performance of organic materials in applications in-

New Nalco Coagulant makes Larger, Heavier Floc . . . Faster

Radically different Nalcolyte 110 used with Conventional Chemicals to Cut Costs, Speed Action in Water Clarification

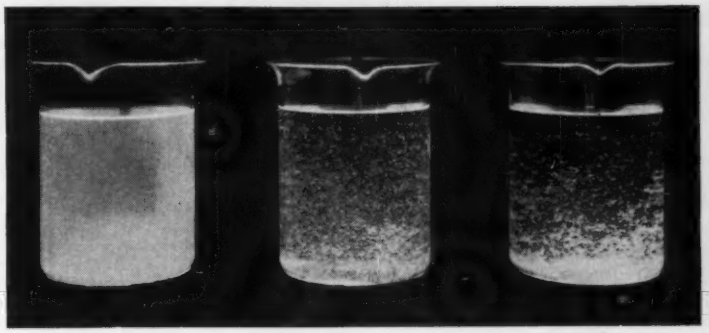


Photo taken in Nalco Laboratories 7 seconds after agitation stopped: *Left*, Control sample of untreated turbid water; *center*, same water, treated with 50 ppm alum; *right*, same water, treated with 20 ppm alum, 1 ppm Nalcolyte 110. Note that large, dense floc is settling out much more rapidly than center alum-treated sample.

Nalcolyte 110 is a non-ionic organic polyelectrolyte flocculant of very high molecular weight—over 1,000,000. It is used in extremely small dosages with conventional coagulants (such as sodium aluminate, alum, ferric sulfate) to increase size, density and uniformity of floc.

Less Chemical; Greater Capacity

Action of Nalcolyte 110 in creating heavier, larger, faster-settling floc not only permits greater throughput rates without floc carryover to processing equipment, but also cuts the total chemical requirements at a resultant cost saving.

In the example illustrated above, only 40% as much alum is required when Nalcolyte 110 is used.

May be Used in Potable Waters

Approved by the U. S. Public Health Service Technical Advisory Committee for use in treatment of public water supplies, Nalcolyte 110 gives water works the opportunity to get appreciably greater capacity from existing clarification equipment—at lower treating cost.

High Suspended Solids No Problem

Waters containing high suspended solids respond quickly to Nalcolyte 110 coagulating action . . . frequently without other coagulant chemicals.

Typical high suspended solids waters which can be treated with speed and economy with Nalcolyte 110 are paper mill white water systems, industrial waste waters, mineral slurries and blast furnace gas wash water slurries.

Nalcolyte 110 Easy to Handle

Nalcolyte 110 is a coarse, white, free-flowing powder of non-toxic character. It is fed in dilute water solutions with standard liquid proportioning pumps or feeders. Stock solutions are prepared at concentrations up to 20%. Packaging is in convenient 25-lb. bags.

Data Available Promptly

Full information on Nalcolyte 110 for your coagulant use is ready to be sent upon your request. Write today, or call your Nalco Representative.

National Aluminate Corporation is now

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Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany
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Nalco CHEMICALS

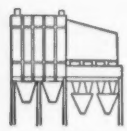
For more facts circle 273 on Reader Service card, p 97

The most efficient operating cyclone collectors made

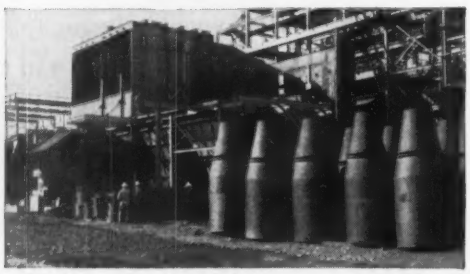
Design makes the difference: in over a thousand plants across the continent, Buell Cyclones have *proved* themselves more efficient than any other cyclones made. Buell's exclusive Shave-off port (A), traps the extra percentage of dust that ordinary cyclones lose. And large-diameter (B), custom-engineered design eliminates bridging, clogging, or plugging during operation, keeps efficiency high without interruption. Regardless of your present or planned plant layout, Buell equipment can be designed to solve your dust collection problems efficiently and economically. There's valuable information in a concise booklet, "The Exclusive Buell Cyclone". Write Dept. 50-H, Buell Engineering Company, Inc., 123 William Street, New York 38, N. Y.

BUELL CYCLONES

"SF" ELECTRIC PRECIPITATORS



PRECIPITATOR-CYCLONE COMBINATIONS



Buell Cyclones before installation at a major plant.

buell®

Experts at delivering Extra Efficiency in

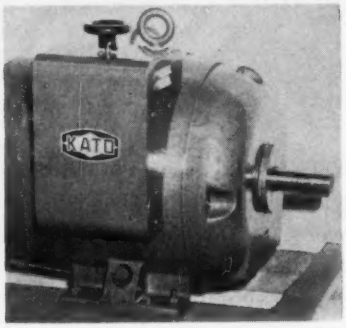
DUST COLLECTION SYSTEMS

Equipment news

Begins on page 110

volving glass fibers—glass or mineral-wool insulation is said to have greater resiliency, heat stability and resistance to moisture damage when the chemical is added. Higher flexural and compressive strengths and improved dielectric properties can result from addition of the amino-silane, which is also a curing agent for epoxy resins.—Dow Corning Corporation

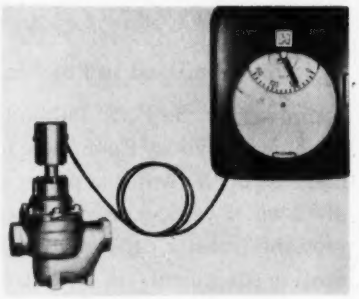
Just circle key numbers on the Reader Service card, page 97, to get complete product story



Dc generators

36 • Sizes ranging from 500 w to 40 kw are now available in dc generators for battery charging, testing or operating dc appliances.

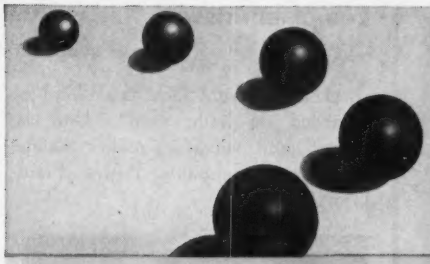
Shunt and compound-wound units are available. Two-bearing generator, above, is rated 6-kw 40/60-v at 1800 rpm. It is a dripproof shunt-wound unit. — Kato Engineering Company



Boiler-water meter

15 • Remote-mounted unit meters, indicates and records total feed to boiler, gives permanent record of output.

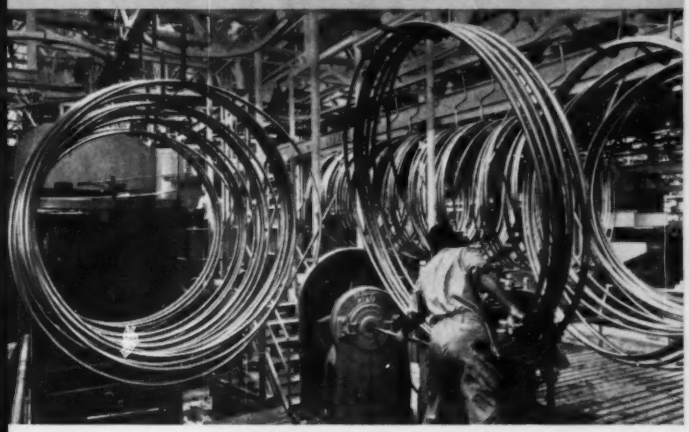
Daily feed loads may be read on continuous-integrating recorder, instantaneous load can be quickly



CALUMET DIVISION

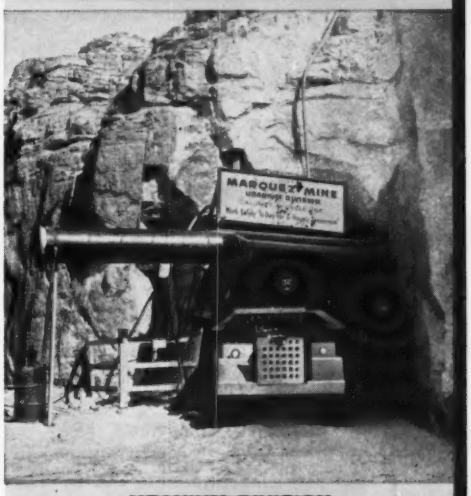
LOOK TO WOLVERINE TUBE

LOOK TO CALUMET & HECLA...



WOLVERINE TUBE DIVISION

GOODMAN LUMBER DIVISION



URANIUM DIVISION

Mining . . . refining . . . lumbering . . . agriculture . . . manufacturing — diversified indeed are the product and market areas of the companies making up the industrial family of Calumet & Hecla, Inc.

Of course, Calumet & Hecla has for many years been recognized as a copper producer. Since 1859, in Michigan's Upper Peninsula, the Calumet Division has been mining Lake copper — one of the purest forms of copper ore. The refined product is sent to Wolverine Tube Division for conversion into brass and copper tubing for plumbing installations, refrigeration, chemical and petroleum processing as well as for a wide variety of general industrial applications. Wolverine Tube is also a prime manufacturer of aluminum extrusions, and drawn and extruded aluminum tube.

The Calumet Division is widely recognized for the quality of the grinding balls and mill liners it manufactures for the mining industry, as well as for the agricultural oxides it produces for better farming.

From the trees in the vast forest areas of Calumet & Hecla holdings, Goodman Lumber Division manufactures plywood and other wooden products. C&H properties have turned up high grade uranium. The development of these properties and the extraction of this valuable element is the responsibility of the Uranium Division.

If any of the above products fall within the scope of your company's requirements, remember that you pick a winner every time you deal with a member of the Calumet & Hecla industrial family.

When you need tubing—LOOK TO WOLVERINE!!

CALUMET & HECLA, INC.
CALUMET DIVISION
URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION

In Canada:
CALUMET & HECLA OF CANADA LIMITED
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO. LTD.
UNIFIN TUBE DIVISION

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Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA.
SALES OFFICES IN PRINCIPAL CITIES.
EXPORT DEPT. 13 E. 40TH ST. NEW YORK 16, N.Y.

For more facts circle 275 on Reader Service card, p 97

cut kw costs on any boiler feed pump!

Borg-Warner Mechanical Seals

Shaft leakage on a boiler feed pump means more than a little lost water. You can actually measure—in BTU's—the heat lost in expensive treated feed water.

"Type D" Borg-Warner Mechanical Seals are designed for the high temperatures and pressures of boiler feed service and cut this leakage to an absolute minimum. At the same time, they eliminate costly maintenance and down-time required with packing or inadequate sealing methods.

The end result is lower pump operating costs, and *lower cost per KW!*

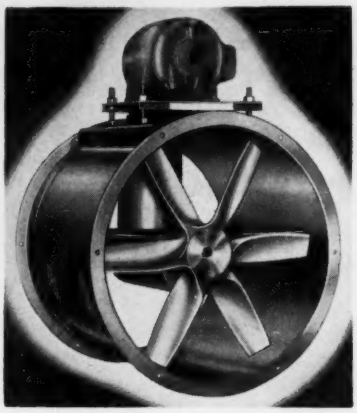
NOW AVAILABLE—*a new 12 page bulletin describing the Borg-Warner Type "D", Seals. Operation, construction, installation and other useful information is included—write for your copy today!*

A PRODUCT OF B-W BORG-WARNER®

Borg-Warner® Mechanical Seals

P.O. Box 2017, Terminal Annex, Los Angeles 54, Calif.

checked on visual face, peak load is recorded on 24-hr chart. Unit is rugged and versatile, maker states. —Henszey Company, Power Plant Equipment Div

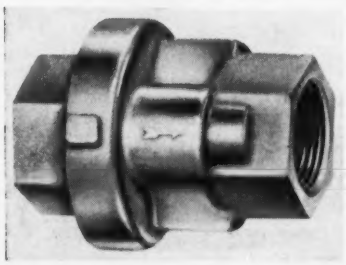


Belt-drive duct fans

42 • Fan speed is adjusted quickly and easily with variable-pitch drives, standard equipment on these redesigned fans. Simple adjustment of driver sheave slows the fan, reduces air deliveries up to 1/3.

Components are completely standardized within each fan size so that a motor change to meet changing air-delivery needs can be made with fan in place. All belt-drive fans of same diameter use same duct, bearing cover, assembly base, shaft and bearings.—Hartzell Propeller Fan Co

Just circle key numbers on the Reader Service card, page 97, to get complete product story



Flow regulator

35 • Unit automatically permits a specified flow rate regardless of inlet pressure. Unusual design means low pressure drop, maker states.

Flow tolerances are maintained to 180 psi, temperatures to 160 F. The unit can handle hot or cold water, and

LIFETIME SERVICE BACKS UP OCOTILLO'S NEW LJUNGSTROMS®

Extremely compact and highly efficient, these baskets of heat transfer surfaces are the heart of the Ljungstrom. (The photo below shows one being lifted into position.) Every inch of these baskets is the approximate equivalent of one foot of a standard tubular heat exchanger. The combined surface of the Ocotillo Air Preheaters provides 263,600 sq ft of heating surface.

The new Ocotillo Power Plant, near Tempe, Ariz., employs four Ljungstrom Air Preheaters for its two 835,000 lbs/hr boilers. Dependability is built into these Ljungstroms, from their corrosion-resistance to their double-life reversible elements (shown in the photo above).

But one of the most important reasons why Ocotillo chose Ljungstrom is Lifetime Air Preheater Service. Throughout the life of each unit (units dating from 1923 are still in operation), Air Preheater engineers make regular calls to inspect the units and keep them in top operating condition.

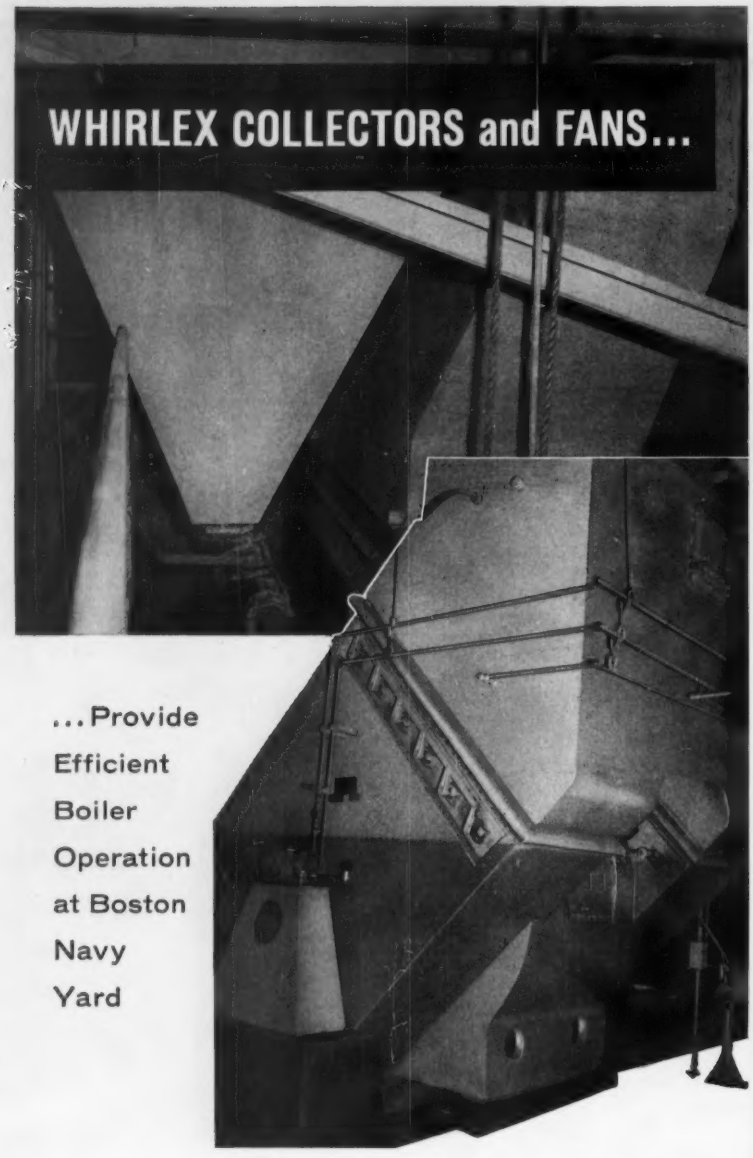
What's more, Air Preheater provides rapid factory service, too. Here's an example: a customer called on a Friday morning requesting immediate shipment of cold-end seals for an Air Preheater. But regular fabrication time would take until the weekend, when no ordinary transportation would be available.

So Air Preheater went to work. Special trucking was arranged. And by a tremendous effort, fabrication was completed *on the same day the order was received* . . . and the customer received the necessary parts *only ten hours after his initial request.*

Fast response to emergencies and regular inspection throughout the life of each Ljungstrom installation are two of the many advantages Air Preheater provides its customers. Another is expert knowledge of boiler and preheater problems—and how to lick them—gained from over 35 years' experience. Perhaps these reasons explain why nine out of ten preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



The WHIRLEX collector and fan shown here are part of an integral system installed at the Boston Navy Yard. The unit is designed to carry hot gases and is complete with a re-injection system. The Whirlex custom built fan is designed to absorb thermal expansion in any direction and features water cooled bearings and built-in inlet damper controls.

Complete information on this and other WHIRLEX installations is available to you at your request.

Fly Ash Arrestor CORPORATION
204 North 1st Street • Birmingham, Alabama

Dust Collectors · Induced Draft Fans · Forced Draft Fans
Exhaust Fans · Self Supporting Stacks · Duct Work

WHIRLEX

comes in 49 flow rates from 0.2 to 50 gpm. It's noiseless at any pressure. —Hays Manufacturing Company, Automatic Controls Div

Just circle key numbers on the Reader Service card, page 97, to get complete product story

Heavy-duty air vibrator

17 • Units unload covered railroad hopper cars fast, maker states. Only moving part, the piston, has long stroke for maximum amplitude and thrust. Stainless-steel mounting head provides long life and there are no body assembly bolts to wear out or fatigue. Two models are made: 3-in.-piston model is 14¼ in. long, weighs 68 lb, uses 18-cfm air at 40 to 60 psi. The 4-in.-piston size is 17½-in. long, weighs 115 lb, uses 29-cfm air at 40 to 60 psi.—National Air Vibrator Company

Circular chart recorders

28 • Recorder-controllers are available with electric or pneumatic controls. All models have constant-voltage supply unit which eliminates batteries, standard cells and standardizing mechanisms in potentiometers. Units are vibration and shock resistant.—Daystrom, Inc, Daystrom-Weston Industrial Div

Versatile design of Organic Power Reactor permits wide variety of fuel elements.

How do you guarantee an atom?

Begin with the knowledge of experienced scientists... conduct a seven-year research and development program ...collect a wealth of solid operating experience. Result: GUARANTEED PERFORMANCE of a nuclear power reactor, designed by Atomics International to help meet the world's power needs.

This is the ORGANIC POWER REACTOR—outgrowth of research and development on the organic system and operation of the Organic Moderated Reactor Experiment (OMRE) conducted by Atomics International for the U.S. Atomic Energy Commission.

Outstanding advantages of the ORGANIC POWER REACTOR: Low capital investment • Low cost operation • High inherent safety and flexibility • Reliability resulting from

- **Non-corrosive moderator coolant • Low pressure system**
- **Conventional, off-the-shelf components and materials**
- **Easy access during operation**

Atomics International is ready to furnish complete ORGANIC REACTOR electric power plants, including fuel elements, in a wide range of power levels. An experienced field staff will assist with initial plant operation, personnel training and maintenance procedures.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

PIONEERS IN THE CREATIVE USE OF THE ATOM

Other offices in: Washington, D.C., U.S.A.; Geneva, Switzerland, Affiliated with: INTERATOM, Bensberg/Cologne, Federal Republic of Germany

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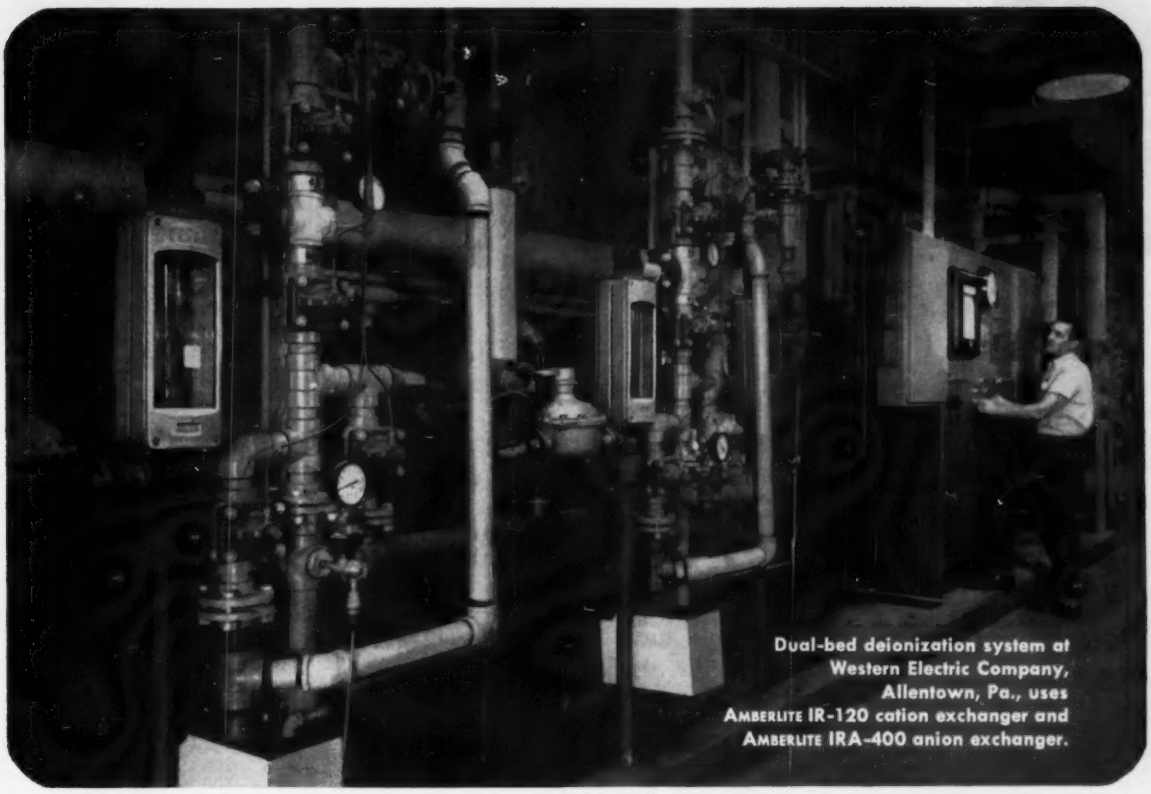
ION EXCHANGE RESINS aid transistor production



Dual-bed deionization system at Western Electric Company, Allentown, Pa., uses AMBERLITE IR-120 cation exchanger and AMBERLITE IRA-400 anion exchanger.

AMBERLITE-deionized water meets critical specifications at Western Electric Allentown Works

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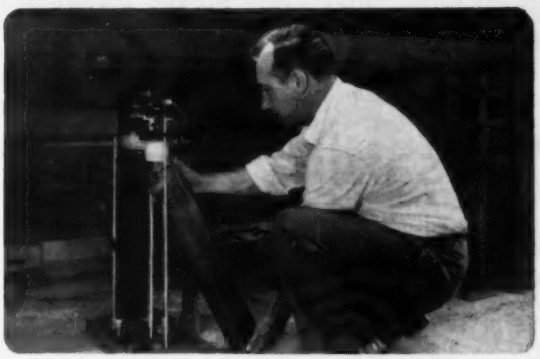

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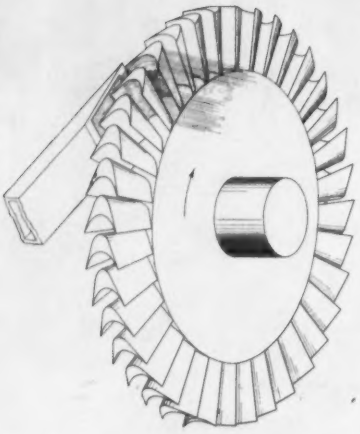
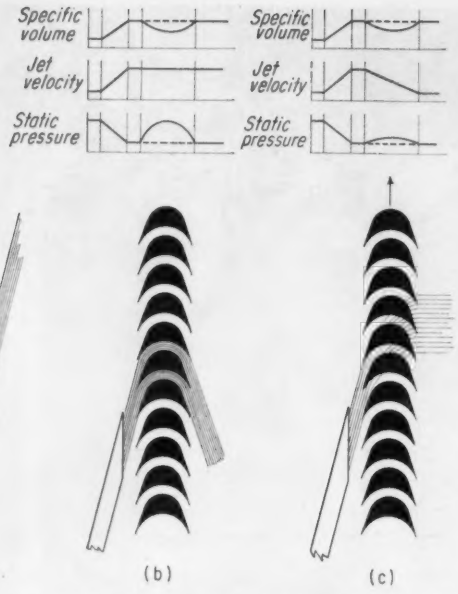


1 In an impulse turbine, gas jet from nozzle flows between moving buckets to develop force for turning the wheel



2 (a) Jet blowing free from the nozzle dissipates itself. (b) With turbine wheel locked, buckets turn jet through large angle. (c) When buckets move, jet turns in smaller angle, slows up

The turbine bucket does a purely mechanical job in absorbing jet kinetic energy to produce mechanical work on a rotating shaft. Nozzle and bucket layout flexibility add up to . . .

By B G A SKROTZKI
Associate Editor

Versatility—the turbine's big feature

Now that we know how nozzles form high-speed jets from a mass of pressurized high-temperature gas, let's learn how turbine buckets convert the gas-jet kinetic energy to mechanical shaft work. For the most part, steam acts almost the same as the gas we'll talk about.

Shaft work. In our air engine, Part 15, January 1958, p 94, we converted gas internal energy into shaft work by letting the bouncing gas molecules do work on a moving piston. In our high-speed gas jet we have molecules all organized to flow in about the same direction, and their stagnation pressure, ideally, equals the pressure of the gas at its source.

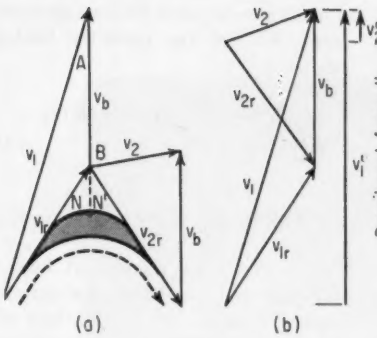
The steady-flowing gas jet makes it unnecessary to use a piston and cylinder with their limiting reciprocating motion. Instead we can use a steady rotating motion—the basis of mechanical shaft work. To make the jet give up its kinetic energy we must reduce its speed while it works on a moving surface. We do this by changing the momentum of the jet as it exerts a working force on some object, Part 6, February 1957, pp 87-89.

Fig. 1 shows the principal working elements of a turbine. The gas jet leaving the nozzle, placed at a sharp angle to the turbine wheel, flows through the passages between the buckets mounted on the wheel perimeter. Keeping the tangential speed of the buckets slower than the jet speed makes the jet turn so it leaves in a general axial direction and at a lower speed than that with which it entered the buckets. In this way jet gives up most of its kinetic energy and does work on the buckets. In other words, the change in momentum of the jet develops a force on the buckets between which the jet passes.

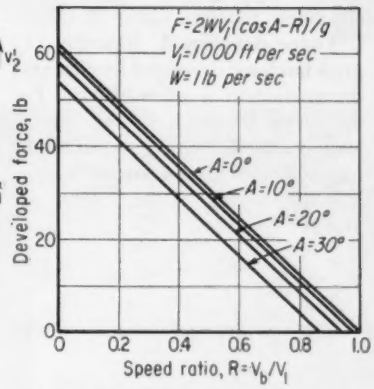
Basic law. Recalling Newton's Second Law of Motion:

$$F = ma = m(v_2 - v_1)/t = (w/g)\ (v_2 - v_1) \qquad (1)$$

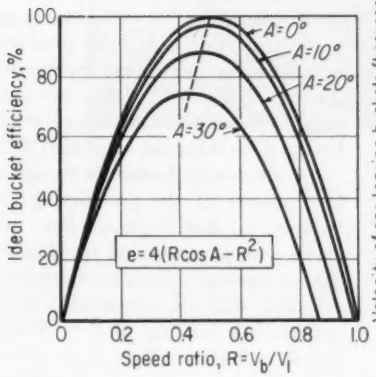
where F = force, lb; m = mass in slugs; v_2 = velocity of jet leaving buckets, ft per sec; v_1 = velocity of



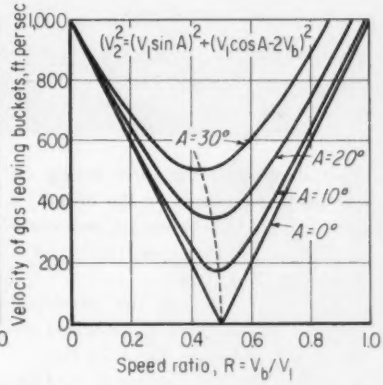
3 Velocity vectors help figure the proper entrance and exit angle of the bucket



4 Impulse turbine develops maximum force with wheel locked at zero speed



5 Impulse turbines work at best efficiency with bucket speed about half jet speed



6 Gas velocity leaving buckets varies inversely as the ideal bucket efficiency

jet leaving nozzle and entering buckets, ft per sec; w = gas flow, lb per sec; g = 32.2 ft per sec, sec.

Speeds can be either positive or negative depending on their direction; since direction plays such an important part, speeds are vector quantities and we can't just add or subtract them arithmetically. Before we get deeper into this let's see how jet and bucket speeds are generally related in an impulse turbine.

Impulse turbine. Fig. 2 shows what happens to a gas jet leaving a nozzle for three conditions. In *a* the jet blows free as it leaves the nozzle and ultimately dissipates in turbulence; this is effectively throttling. In *b* we look at the edge of the turbine wheel and nozzle and redraw the buckets as if they were arranged on a flat surface. By locking the turbine wheel so it can't move we make the stationary buckets act as guides to force the gas jet to turn through almost a 180-deg angle. This develops maximum force on the buckets, but no work because the force doesn't move. Ideally the jet leaves the buckets with the same velocity that it enters with. This means the jet retains its kinetic energy and transfers none to the turbine wheel and shaft.

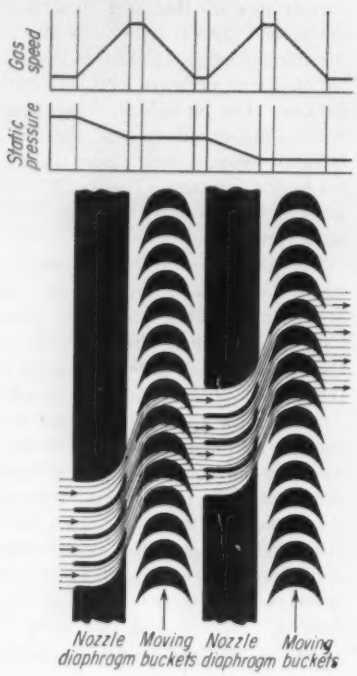
The graphs, Fig. 2, show what happens to the gas jet as it flows through nozzle and buckets. The static pressure drops while the gas flows through the nozzle; then it rises while the jet direction changes, but falls to the nozzle discharge pressure as it leaves the buckets. The jet velocity rises while flowing through the nozzle, but ideally stays constant as it passes through the bucket passages. The specific volume of the gas acts inversely to the static pressure.

Fig. 2*c* shows the buckets moving while the jet flows through the passages, the buckets moving at about half the jet speed. This turns the jet through less than a 90-deg angle in the bucket passages. The graphs, Fig. 2, show that the pressure and specific volume behave as about in *b* with less change, but the jet velocity drops markedly when flowing through the buckets. The jet develops a force about half that in *b*, the locked-wheel condition, but since the force can move it does work on the moving buckets. The jet does this work by giving up much of its kinetic energy and so slowing down.

In the impulse turbine the gas static pressure is the same at the bucket entrance and exit sections. If the pressure is allowed to drop, the buckets act as moving nozzles and we have a reaction turbine—more about this later.

Velocity relations. Fig. 1 and 2 suggest that we can choose a wide variety of angles between the nozzle axis and the turbine-wheel plane. We can also have ratios of bucket speed to jet speed varying from zero to unity. Fig. 3*a* shows how these variables are related. Vector v_1 shows the direction of the gas jet leaving the nozzle, its length measuring the speed. Vector v_b shows the direction and speed of the buckets. The angle A is the angle between the nozzle axis and the wheel plane.

By subtracting v_b vectorially from v_1 we get v_{1r} the jet velocity relative to the moving buckets. As we expect, the latter is much less than v_1, but it makes an angle N with the wheel plane, appreciably larger than A. To make the jet enter the bucket passages smoothly, the entering edge of the bucket must be made equal to N rather than A. A number of factors determines the best leaving angle for the bucket, N', in actual turbines, but ideally we can make $N' = N$. For the ideal condition there is no friction between jet and bucket face and the



7 Pressure-compounded impulse turbine has smaller pressure drop in stages

jet leaving velocity relative to the bucket $v_{2r} = v_{1r}$, the relative jet entering velocity.

We must find the jet absolute velocity leaving the bucket to learn how much kinetic energy was given up by the jet in doing work on the bucket. We do this by adding another v_b vector to the end of v_{2r} and complete the triangle with v_2, the absolute velocity of the leaving jet.

The shaded arc in Fig. 3*a* shows how the vector study fixes the general shape of the turbine bucket. For turbines running at variable speed or with large load variations at constant speed, the entering edge of the bucket would probably have a round nose rather than the sharp edge shown. This reduces turbulence of the jet entering bucket passages and gives better aerodynamic flow characteristics. The leaving edge would also be rounded to a lesser degree to give better mechanical strength. The dashed line shows the flow of the steam relative to the bucket. Fig. 3*b* rearranges the velocity vectors about one single v_b to make certain trigonometric relations easier to follow.

Force developed. Equation (1) gives the force developed by changing the momentum of a flow of fluid. For the turbine wheel, only the component of the velocity parallel to the bucket motion plays a part in developing the moving force. Then for Fig. 3*b*:

$$F = \frac{w}{g}\ (v'_1 - v'_2) \qquad (2)$$

$$= \frac{w}{g}\ (v_1 \cos A - v_2 \cos B) \qquad (3)$$

$$= \frac{w}{g}\ (v_{1r} \cos N + v_{2r} \cos N') \qquad (4)$$

We'll limit our study to ideal symmetrical buckets where $N = N'$ and $v_{1r} = v_{2r}$, then:

$$F = \frac{w}{g} 2 v_{1r} \cos N \qquad (5)$$

$$= \frac{w}{g} 2 (v_1 \cos A - v_b) \qquad (6)$$

Letting $R = v_b/v_1$, the bucket-jet speed ratio, we have:

$$F = \frac{w}{g} 2 v_1 (\cos A - R) \qquad (7)$$

This shows that the force acting on the buckets depends on the initial jet velocity, angle between jet and wheel and the bucket-jet speed ratio for a given jet flow rate.

Fig. 4 shows how the developed force varies ideally with jet-wheel angle and speed ratio for a jet flow of 1 lb per sec and jet speed of 1000 ft per sec. Each set of conditions would have its own unique bucket shape. The developed force is maximum at zero speed ratio, that is, locked wheel condition. But as the wheel speeds up, the developed force drops to zero as bucket speed approaches jet speed.

A jet-wheel angle $A = 0$ gives maximum force at any given speed ratio. As the angle grows the force drops at an increasing rate showing the need to keep A as small as conditions will allow.

Bucket efficiency. Now we must find the conditions that will develop maximum shaft energy output. Let's do this in terms of power developed by the buckets:

$$P = F v_b = \frac{2 v_1 w}{g} (\cos A - R) v_b \qquad (8)$$

This is the output of the turbine in terms of ft-lb per sec. The input is the kinetic energy of the jet, $K = w v_1^2/2g$, also in ft-lb per sec. When the ratio of output to input reaches a maximum we have the best arrangement. We call the ratio the bucket efficiency:

$$BE = \frac{P}{K} = \frac{\frac{w v_1^2}{g} (\cos A - R) v_b}{\frac{w v_1^2}{2g}} \qquad (9)$$

$$BE = 4R(\cos A - R) \qquad (10)$$

Fig. 5 shows the relation of bucket efficiency and speed ratio for various jet-wheel angles. At $A = 0$, best efficiency of 100% is achieved at a jet-wheel speed ratio of 0.5. Maximum efficiency for each given A is at a speed just one-half the speed at which F becomes zero.

Comparing Fig. 5 and 4 we find that at best bucket efficiency for each A, the developed force is just one-half the force produced at locked wheel condition, $R = 0$. This means that at startup a turbine produces maximum torque, a good feature for starting under load. Keep in mind that the bucket has a unique shape for each combination of A and R.

An interesting feature is the absolute velocity of the gas leaving the buckets, v_2. Fig. 6 shows how this varies with jet angle and speed ratio. We can have quite high leaving velocities and still get respectable work outputs. For example, at $A = 30$ deg and $R = 0.433$ we have $v_2 = 500$ ft per sec for $v_1 = 1000$ ft per sec. While the ratio of exit to entering velocity is $500/1000 = 0.5$ the ratio of corresponding kinetic energies is $500^2/1000^2 = 0.25$; the major part of the energy has been converted even for these relatively unfavorable conditions. The corresponding bucket efficiency is 75% as shown in Fig. 5. At only one condition, R = 0.5 and $A =$ 0 deg, can we have $v_2 = 0$, as shown in Fig. 6. This is a theoretical ideal condition not obtainable in practice.

Compounding. From Part 29 we learned that the nozzle jet velocity depended on the pressure drop of the gas flowing through. On a given turbine we usually have a given overall pressure drop available. If we passed the gas through a set of parallel nozzles placed between the total pressure drop we might find that we get very high gas jet velocities.

The corresponding bucket velocity we might have to use for good efficiency could put a severe centrifugal

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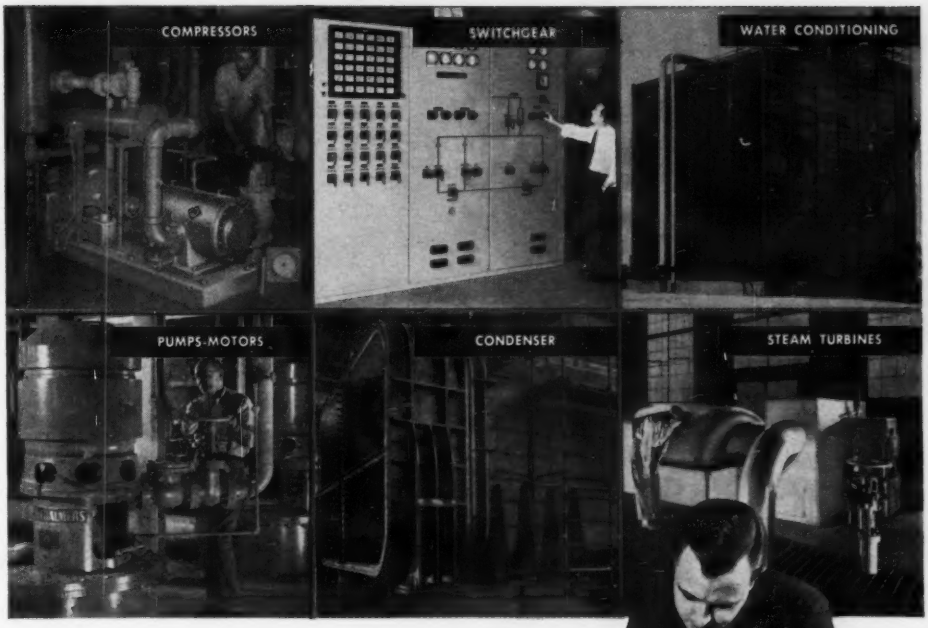

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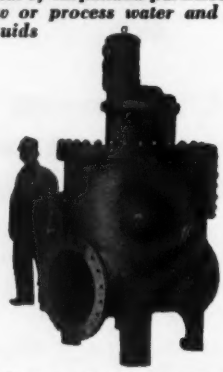

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Turbine versatility

Continued from page 138

strain on the turbine wheel making it impossible to run safely. To avoid this condition, we can place two or more sets of nozzles and buckets in series between the inlet and outlet pressures. All the gas flowing through the first set of nozzles and buckets would expand to an intermediate pressure producing a moderate jet velocity. From the first set of buckets, the gas would then expand through the next set of nozzles and buckets at a moderate velocity. Any number of sets could be used to achieve the best jet velocity in each set or stage between the turbine inlet and final outlet pressures.

This arrangement, Fig. 7, is called pressure compounding. While the pressure drops steadily through the stages, the gas speed alternately rises in the nozzles and drops in the buckets. The gas specific volume rises as the pressure drops, so succeeding stages must have larger cross-sectional areas to handle the increasing volume flow. This can be done by increasing the number of nozzles per stage, by raising the height of the nozzles and buckets, or by increasing the diameter of the diaphragms supporting the nozzles and of the wheel holding the buckets.

Next part will cover velocity compounding and reaction blading—in a forthcoming issue.

Rent or buy decision for automatic data-processing equipment must be based on a consideration of functional, economic and technological role of the equipment. Properly planned installation should be useful for at least ten years, says management consultant N J Dean.

British Admiralty is studying marine-reactor designs, planning nuclear-powered ships to operate at about 105% of conventional costs by 1961.

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Want more protective relay-equipped switchgear facts? Contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

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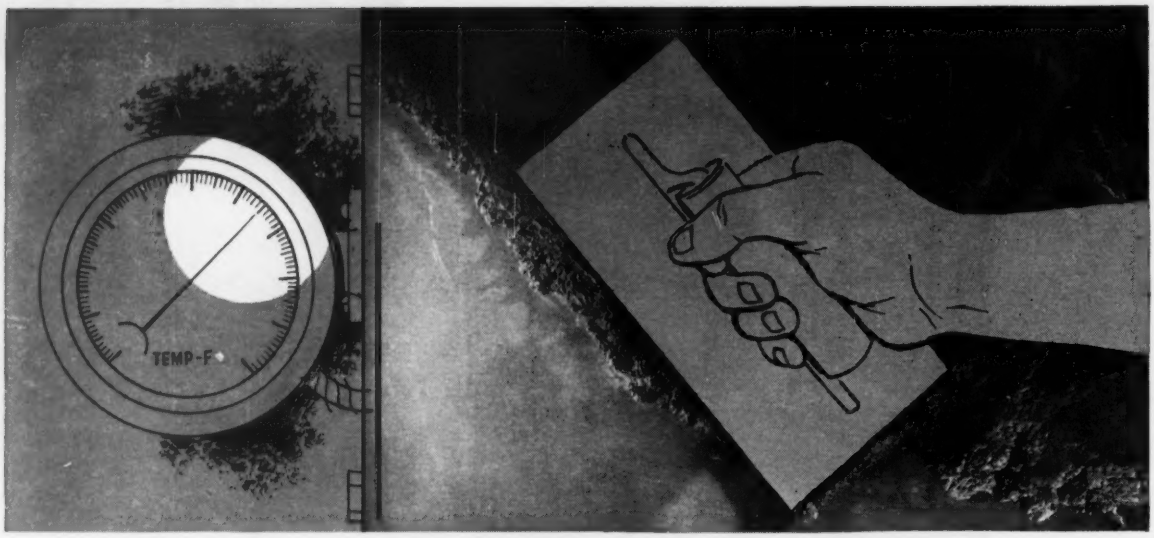

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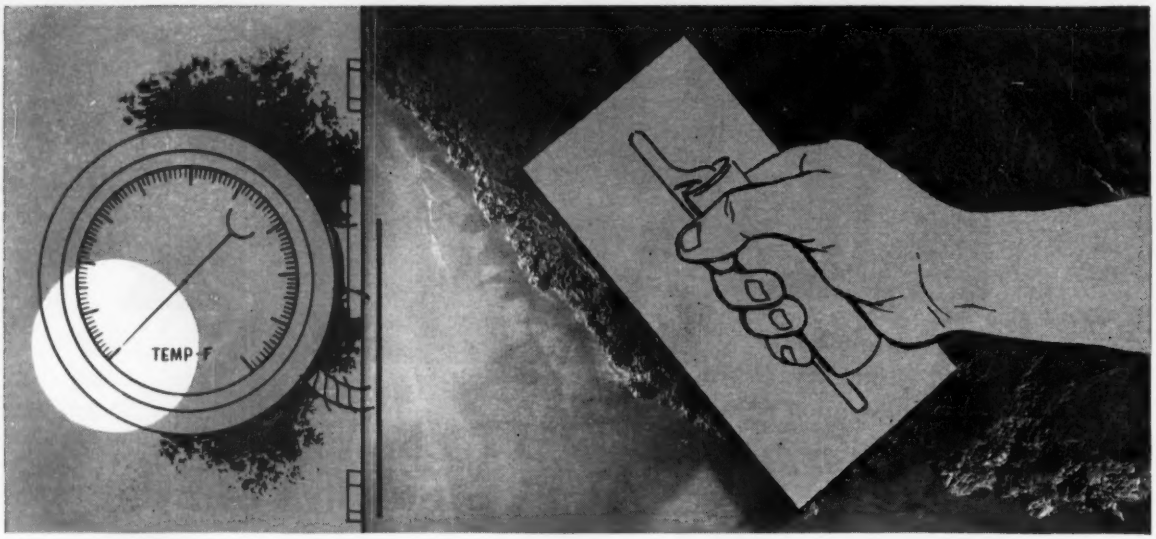

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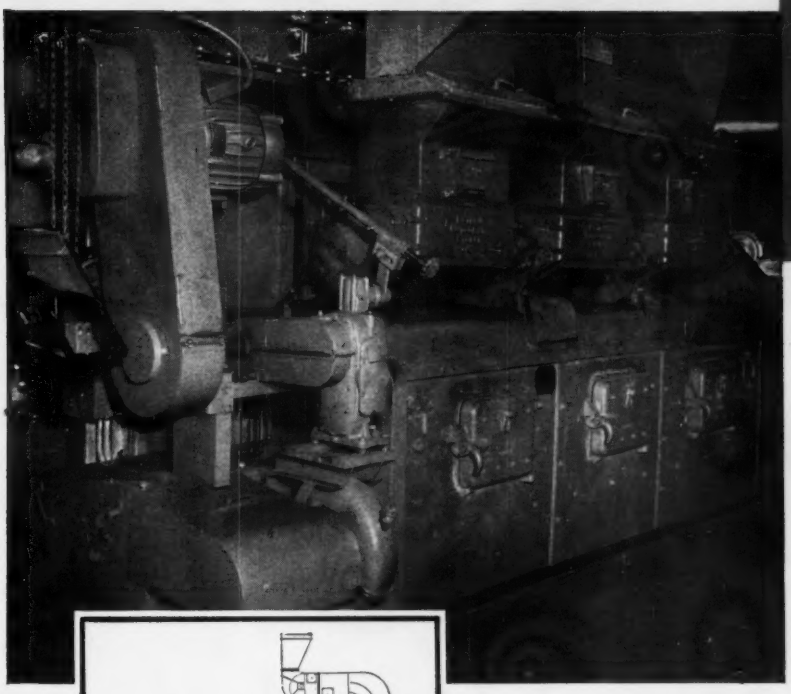
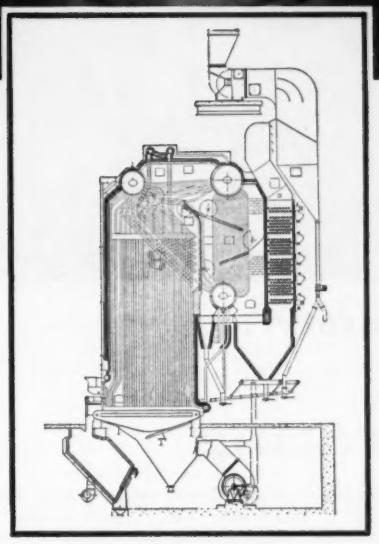


A Detroit RotoGrate Stoker



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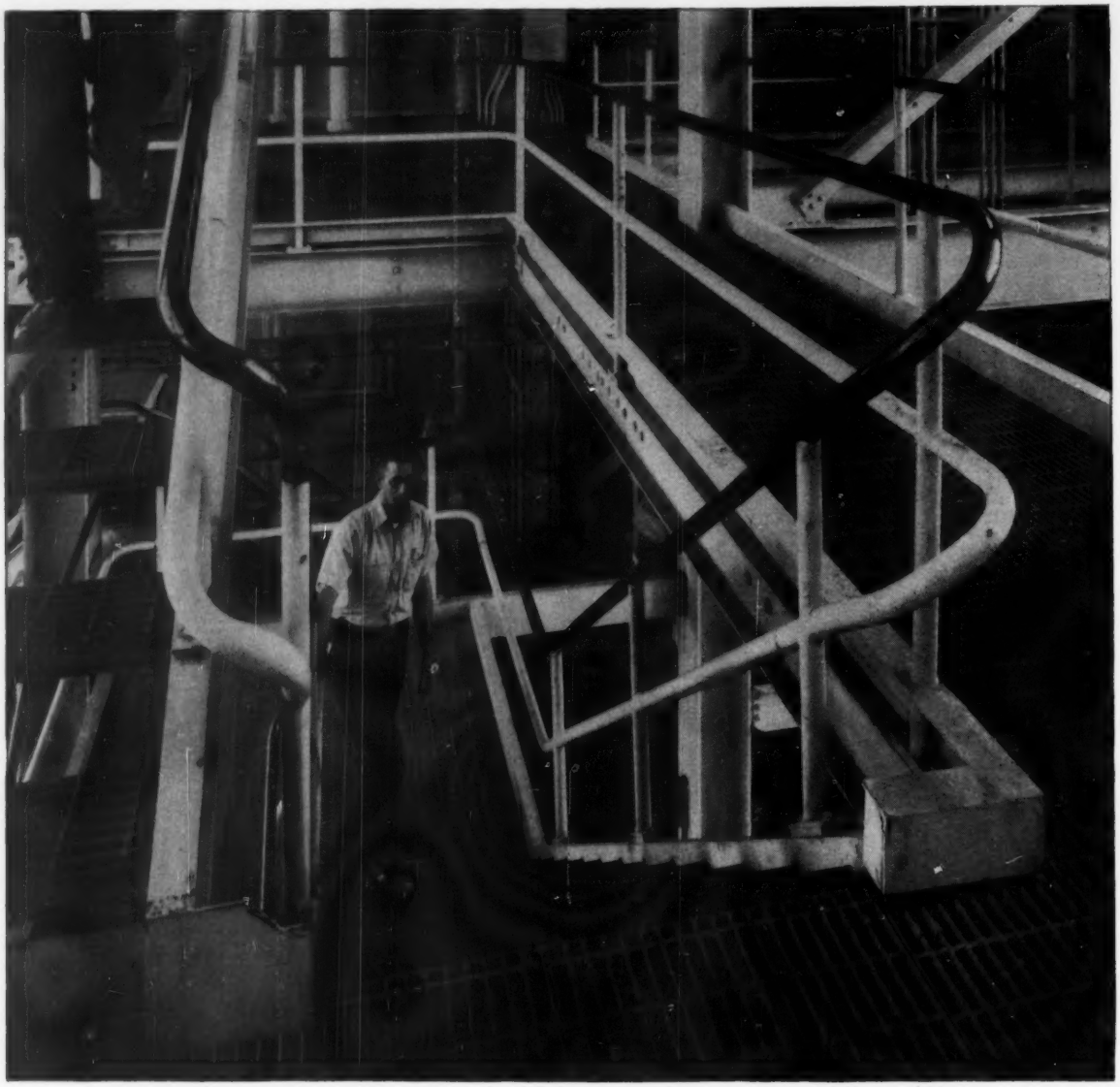

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A primary function of open flooring is to admit light and air to areas above and below its surface . . . to provide safer, more comfortable working conditions. Blaw-Knox Electroforged Steel Grating is designed to provide maximum open area.

Load requirements establish equal bearing bar dimensions for all types of grating, in equal service. Because it is Electroforged, Blaw-Knox grating can get maximum strength from crossbars only ¼ inch square. This means less obstruction to light and air, and safer, more comfortable working conditions above and below.

Visibility is only one way Electroforged grating increases safety. Sure footing is provided by the nonslip, twisted crossbar and a choice of either square, or serrated bearing bars. Electroforged grating is self cleaning, too. There are no joints or crevices to collect dirt and grease.

For more information on how to specify the Blaw-Knox Electroforged Steel Grating best suited to your needs, write for Bulletin 2527-R.

BLAW-KNOX

BLAW-KNOX COMPANY
Blaw-Knox Equipment Division
Dept. Y, Pittsburgh 38, Pennsylvania

For more facts circle 289 on Reader Service card, p 97

• • • "Frictionless" design gives Flexotrol* longest life, stability and accuracy of any displacement level controller

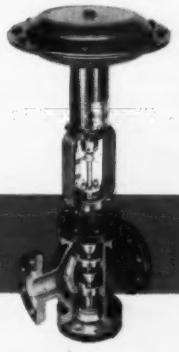
By avoiding knife edges, bearings and associated pressure-tight mechanical fittings, K & M has achieved almost frictionless operation in the *Flexotrol* Displacement-Type Liquid Level Controller. As a result, errors due to friction, distortion and hysteresis are practically nil.

Actuation is accomplished through a torque element which directly transfers displacer movement to the controller. There are no intermediate levers. Because the rotation of the tube is limited (4°) and because the whole assembly is constructed of high-durability materials, the torque system has remarkable fatigue resistance. Tests in excess of five million operating cycles have produced no detrimental fatigue effect.

The controller unit utilizes conventional 3-15 psi signal air pressure, has a 0-150% adjustable proportional band, may be direct-, reverse- or snap-acting without parts change. The *Flexotrol* Level Controller can also be converted to a transmitter-controller combination. Automatic reset and rate response are optionally available.

Full details are given in Bulletin 456-1. A copy is yours for the asking.

*Flexotrol is a trade-name of Kieley & Mueller, Inc.



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diaphragm control valves

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KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer

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S.A. 1935

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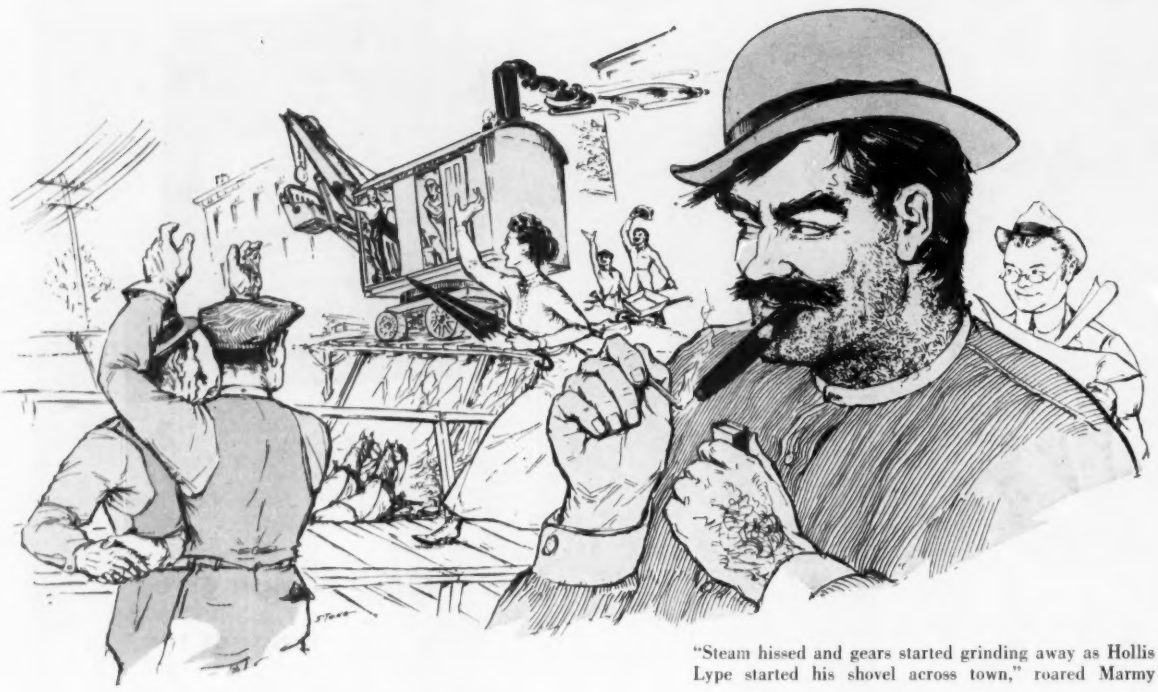


"Steam hissed and gears started grinding away as Hollis Lype started his shovel across town," roared Marmy

Marmy's shovel job

Starting a new feature, as we did with our *Equipment Design of the Month* in January, is always exciting. For one thing, this single-page feature gives every firm an opportunity to tell 50,000 topnotch POWER readers about their brainchild, and it costs them nothing. For example, the January story on a new evaporative condenser brought in over 500 inquiries from around the world in the first six weeks after publication. But the revolutionary centrifugal-action steam generator in May is what really rang the bell with steam engineers, especially the old-timers.

Wonder what Marmaduke thinks of this novel way of making steam, I asked myself. Soon afterwards I was headed for the Bent Propeller Bar to get the old consultant's views.

No sooner had I edged up to the crowded bar and ordered a short beer when Marmaduke Surfaceblow barged in. He seemed deep in thought, looked at no one, but navigated straight for the bar. "There's Marmy," everyone seemed to echo as the tall, dignified consultant elbowed his way to his accustomed place at the north end of the crowded bar.

Bedlam didn't say a word, but quickly pushed a bottle of Sandpaper Gin before his star customer. Marmy limbered up his cargo loading boom, then quickly ballasted his double bottoms with a good, long shot.

Soon as he came up for air I shoved the May issue before him and timidly asked, "Mr Surfaceblow, what does an old-time steam man like you think of generating steam with this new centrifugal-action generator?" But that's as far as I got.

"BILGEWATER on newfangled steam kettles," roared Marmy in his foghorn voice. "I'll tell you land lubbers about a steam shovel that had everything, but still wasn't worth bilgewater because the operator's noggin carried a perfect vacuum."

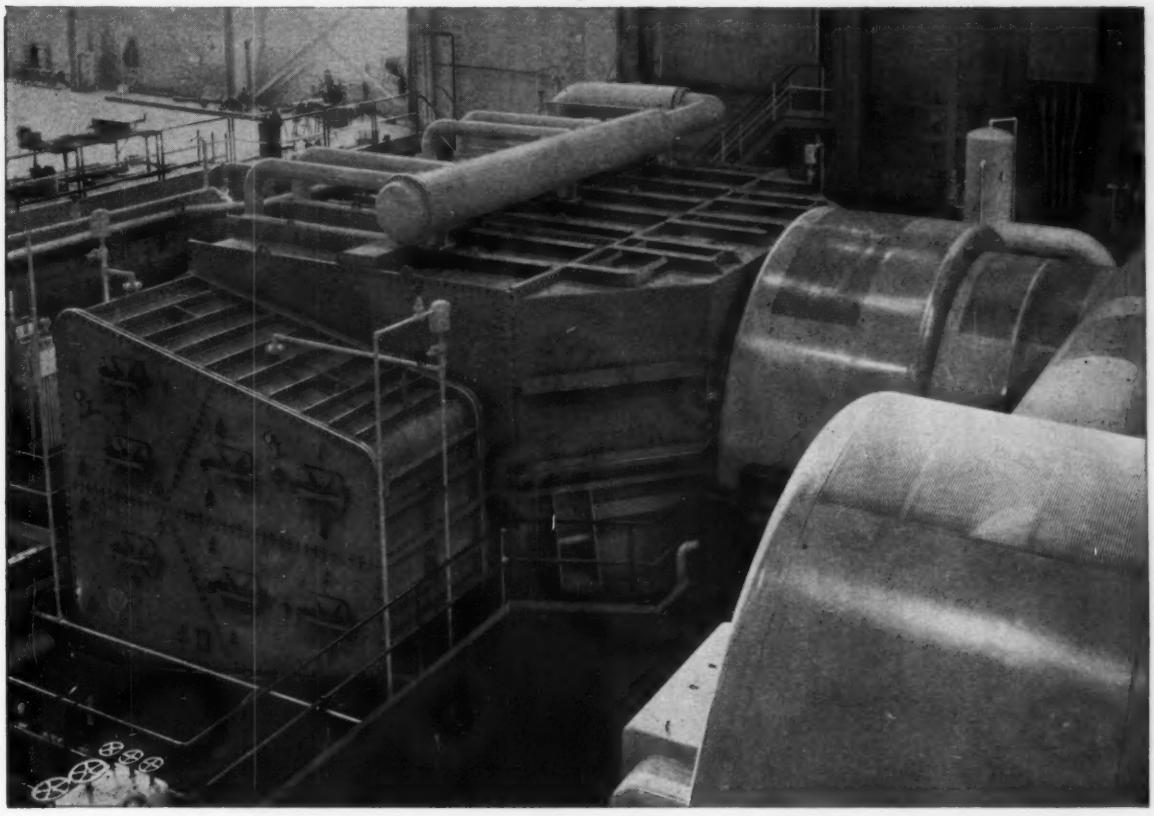
That did it. The noisy conversation stopped. All eyes focused in Marmy's direction. Turning toward his audience, this outstanding engineer of land and sea continued blasting away with a burst of thunder.

"Back in 1921 I was a licensed steam-shovel operator in Ottawa, Canada. We were on a big construction job with four other shovels so there was plenty of competition. Each shovel operator tried to prove his worth by removing more tonnage than the others.

"My fireman was Hollis Lype, a big raw-boned kid from the country. Hollis was the super's nephew and had plenty of ambition. He was willing to give his right eye to be a licensed shovel operator. So he studied hard and ran me ragged answering his questions.

"Whenever he wasn't firing and oiling, he'd watch me working those controls. And I could make that big shovel do her stuff in the excavation ditch as daintily as a ballerina dancing across a stage.

"Because Hollis showed such an interest I'd let him play with the controls every chance I had, so he'd be sure to pass his examination. Besides, his uncle was my old shipmate and a regular Joe. But I became sadly disappointed. Soon as Hollis felt he knew a few things about the steam



Ingersoll-Rand Steam Condenser Serves

AXIAL-EXHAUST turbine

at MECO's Portland Station

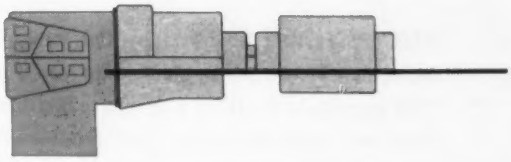
METROPOLITAN EDISON COMPANY'S new 165,000-kw Portland Station, designed and built by Gilbert Associates, Inc., features many advances in central station design—including the Ingersoll-Rand 80,000 sq. ft. surface condenser shown above.

To meet the unusual requirements of the axial-exhaust turbine and Monotube boiler, the condenser design incorporates the following features:

- Straight-through, horizontal steam path engineered for minimum friction and maximum pressure recovery . . . higher cycle efficiency.
- Reversible single-pass counter-flow cooling water circuit, convertible to two-pass operation.
- Hotwell storage of 16,000 gallons of deaerated condensate.
- Condenser is designed to receive steam by-passed from the Monotube boiler and features a built-in attemperating device.
- Welded tube ends prevent any possibility of feedwater contamination.

The Ingersoll-Rand condenser auxiliaries include circulating pumps, condensate pumps and air removal equipment consisting of two mechanical vacuum pumps with primary air-jet boosters. (Compressed air for soot-blowing and instrumentation is produced by Ingersoll-Rand compressors.)

For full details on this advanced condenser design, send for a copy of "The Condenser at Portland," Form 9306.



Simplified drawing of the Ingersoll-Rand 80,000 sq ft surface condenser connected to the axial exhaust turbine.

Ingersoll-Rand

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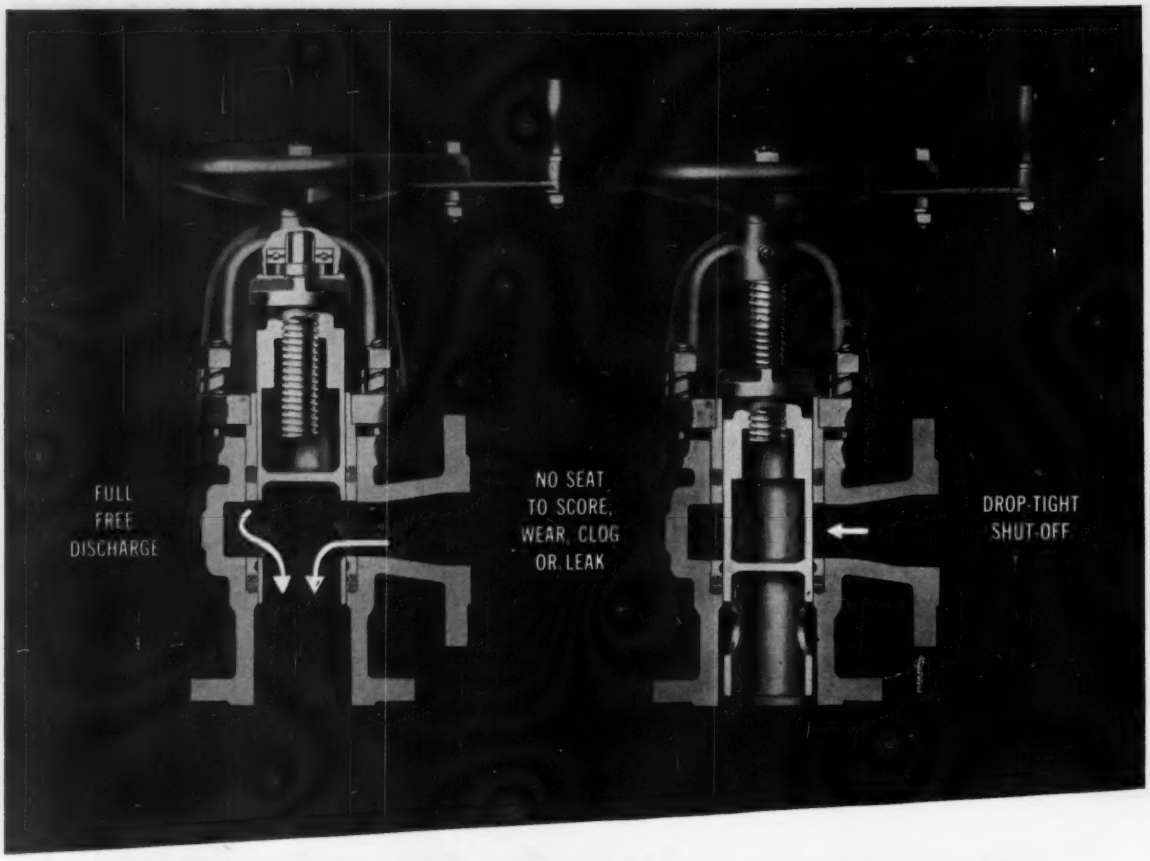
COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS



open and shut case!

...FOR TROUBLE-FREE PERFORMANCE WITH YARWAY SEATLESS BLOW-OFF VALVES

Mention Yarway Seatless Blow-Off Valves in more than 16,000 boiler plants, and you'll get solid approval—for these plants have first-hand *experience* with the dependable, trouble-free, service of Yarways.

For boiler blow-down service at all pressures up to 415 psi, YARWAY SEATLESS (in tandem) is the popular choice.

Outstanding feature is the famous seatless design—*there is no seat to score, wear, clog or leak*. Nitralloy hollow sliding plunger permits full, free discharge, yet keeps valve drop-tight in closed position. *No other blow-off valve has these features.*

Specify Yarway Seatless Valves when ordering new boilers and when replacing worn or inefficient blow-off valves on your present boilers.

Yarway Bulletin B-427 gives full information. Write for it today.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

Continued from page 146

shovel, he repaid me by starting to tell me how to run my job.

"After a while, every time Hollis had a chance to watch me, he'd tap me on the shoulder and say, 'Marmy, now if I was doing that. . . .' At first I thought he was kidding. But then I saw he was naturally a wise guy.

"After a few months of this brash attitude Hollis started getting under my skin. He had no original ideas himself, but he'd always tell me something he had read, or play back information I had told him. Only trouble was that he seemed to scramble everything he was told.

"My one consolation was that if I helped him get enough information to get his operator's papers, he'd be off my neck. Then I could start in with a new man. After all, how many Hollises are there in the world? So I tried to be patient. But Hollis took my patience for ignorance and really started to straighten me out on boiler, steam engine and shovel operation.

"To make sure he'd take his examination first chance he had, I kept telling him of all the money he'd make as a licensed operator. That made Hollis' eyes light up and glow like Christmas bulbs. Then I'd give him a snow job about all the sidewalk superintendents—many of them attractive gals—who'd admiringly watch him work a big shovel. That's when Hollis really tore into his books.

"So before long he was ready to take his exams. We were all surprised that he passed. When he came back to the job his chest was sticking out, and his head several sizes larger. Hollis bragged not only of how he passed his exam, but told us how he straightened out the examiner on a few of the finer points. I congratulated him and wished him luck. So did everyone else on the job. At long last we were about rid of him, so we all felt better.

"The very next week Hollis got his first break as a licensed steam shovel operator. His uncle asked him to deliver one of the newer shovels from our job to another job starting across town. The shovel was a dandy piece of machinery, with all the latest wrinkles. In those days a shovel went from one job to another under its own power. If the roads were paved, the wheel cleats were taken off to prevent gouging out the pavement. I wanted to give that showoff some advice about making that cross-town trip, but I knew he wouldn't listen.

"Assigned to Hollis' shovel as fireman was Pete Rademaker, one of the old-timers. So Hollis was in his glory. Although Pete knew his firing job inside out, Hollis gave him all kinds of instructions. Pete was good-natured and took it without batting an eye. Hollis loved to talk, and in his fireman he had a captive audience. So Pete just stood there and listened.

"After they had steam up on the boiler and the machinery oiled, Hollis tried to impress Pete once more by giving him a last round of instructions. 'Now don't forget to rake your fire . . . be sure to carry the water in the gage glass so high . . . don't forget to swab the piston rods . . . be sure to give your fires enough air . . . don't touch anything until you ask me' . . . and so on and so on.

"Finally even good-natured Pete became slap happy with all that advice. He'd just stand there patiently saying 'yes,' 'okay' and 'sure,' laughing to himself. Before long the safety valve was popping so Hollis seated himself at the controls. Even Hollis' girl friend was there to see him off. She kept hollering to him that she'd go across town to see him do his stuff when he arrived on the new construction job.

"So Hollis sat proudly at the controls, smiling from ear to ear. This was the biggest day in his life and you'd think he was about to pilot the *SS Mauretania* on her maiden voyage. Then came the grand moment. Hollis opened the throttle. Steam hissed and gears started grinding away as the big shovel took off down the street. My good friend, Joe Bongiorno, and the other operators on the job waved to Hollis. They slapped each other on the back for having him out of their hair at long last.

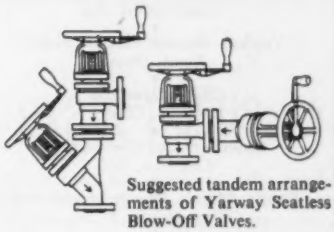
Before long Hollis' shovel was chugging along in midtown traffic. Spectators lined the sidewalks to watch the rattling iron monster. Hollis was in the limelight, and like most people he loved every second of it. Soon he came to the first set of double street-car tracks at Laurier Avenue

SIGN OF A GOOD PACKAGE BOILER

There are many good makes of package boilers—and practically all have this in common:

YARWAY BLOW-OFF VALVES

Names like Keeler, Combustion Engineering, Erie City, Cleaver-Brooks, Preferred Utilities, Titusville, Kewanee-Springfield and many others offer the known dependability of Yarway Seatless Blow-Off Valves. Many of them use Yarway as their standard.



Suggested tandem arrangements of Yarway Seatless Blow-Off Valves.

Look for Yarway Blow-Off Valves on *your* next package boilers. If they're not included, specify them to the manufacturer. For all the reasons, write for Bulletin B-427.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
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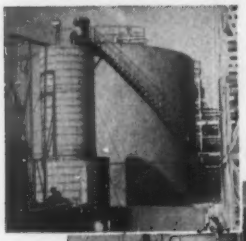
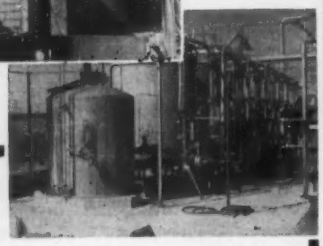
A MARK OF QUALITY IN STEAM ENGINEERING

WHO CHOSE H&T ?

For Boiler Feedwater Conditioning Equipment



400,000 lb. per hour fully automatic demineralizer plant with silica and CO_2 removal



These Fine Companies Did!

A Partial List of Installations

Duquesne Light Co.
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Ohio-Edison Co.
Akron, Ohio

Bowaters-Carolina Corp.
Catawba, S.C.

Knolls Atomic Power Laboratory
West Milton, N. Y.

The Cleveland Elec. Illuminating Co.
Ashtabula, Ohio

Chevrolet Div. Gen. Motors Corp.
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Tampa, Florida

U. S. Gypsum Co.
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50 Years of Progress

HUNGERFORD & TERRY, Inc.
CLAYTON 3 NEW JERSEY
H&T SERVICE

Marmaduke

Continued from page 149

in the middle of Ottawa—the only serious hazard on his route. The busy traffic cop gave him the sign, so away went Hollis in high gear, giving the spectators something worth looking at.

"But just as Hollis got his steam monster to the center of the tracks at full speed, there was a violent explosion overhead. Hollis had never seen a shower of lightning arcs like that before. Neither had anyone else.

"Looking quickly in back of him he saw that his boiler was still aboard. Just then Pete the fireman looked up from his boiler and let out a yell you could hear up in Alaska, for he saw the shovel's smokestack melting the overhead swaying trolley wires. Even fireman Pete knew that the 600 volts in those wires could mean sudden death. The traffic cop started blowing his shrill whistle and motioned wildly for Hollis to back up.

"But Hollis miraculously had melted the first trolley without killing anyone. He grimly hung on to the throttle for dear life. His only idea was to pass the second trolley. That was too much for Pete. He let out another yell and abandoned ship, jumping to the street and running away from there for all he was worth. By then the traffic cop and everyone had scattered. Then it happened—another terrific explosion as the stack hit the second trolley.

"This time Hollis didn't know what to do. Should he keep going ahead, astern, or stop? The trolley melted in two and the thick copper wires draped over the boiler stack and the shovel's boom like spaghetti, sending up a shower of dazzling sparks. What kept Hollis from being barbecued is something I'll never know.

"In the meantime the substation breakers had kicked out. Hollis saw the street-car lights go out, but they didn't mean anything to his paralyzed brain. He was stiff with fear, but had enough presence of mind to automatically inch the shovel across the street and park at the curb. At least his shovel wouldn't tie up traffic.

"But the knowledge that he had come face to face with sudden death and that his life had been spared was too much for Hollis. Like many guys who live miraculously through a

CHEMTROL PLASTIC VALVES

BALL VALVE

Union-type end connectors, full-flow, quick opening, non-porous, never stick or gall, lightweight. ½" to 4" I.P.S.

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Full-flow, designed for minimum of head loss. New principle of seat seal for high and low pressure. ½" to 2" I.P.S.

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COCK VALVE

Teflon sealed, non-sticking full-flow cock for corrosion-service applications. ⅛" and ¼" I.P.S. and hose connectors.

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Precise metering control and recording of settings, non-scaling, gall-proof needle. Resists internal, external corrosion. ¼"N.P.T.

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Fast opening and closing Teflon seats assure positive, "non-stick" seating in corrosive and scaling conditions. ¼" N.P.T.

Chemtrol valves, manufactured from a variety of plastic materials, are engineered for a wide range of corrosive environments, temperatures and pressures. Write for our handbook on plastic piping systems.
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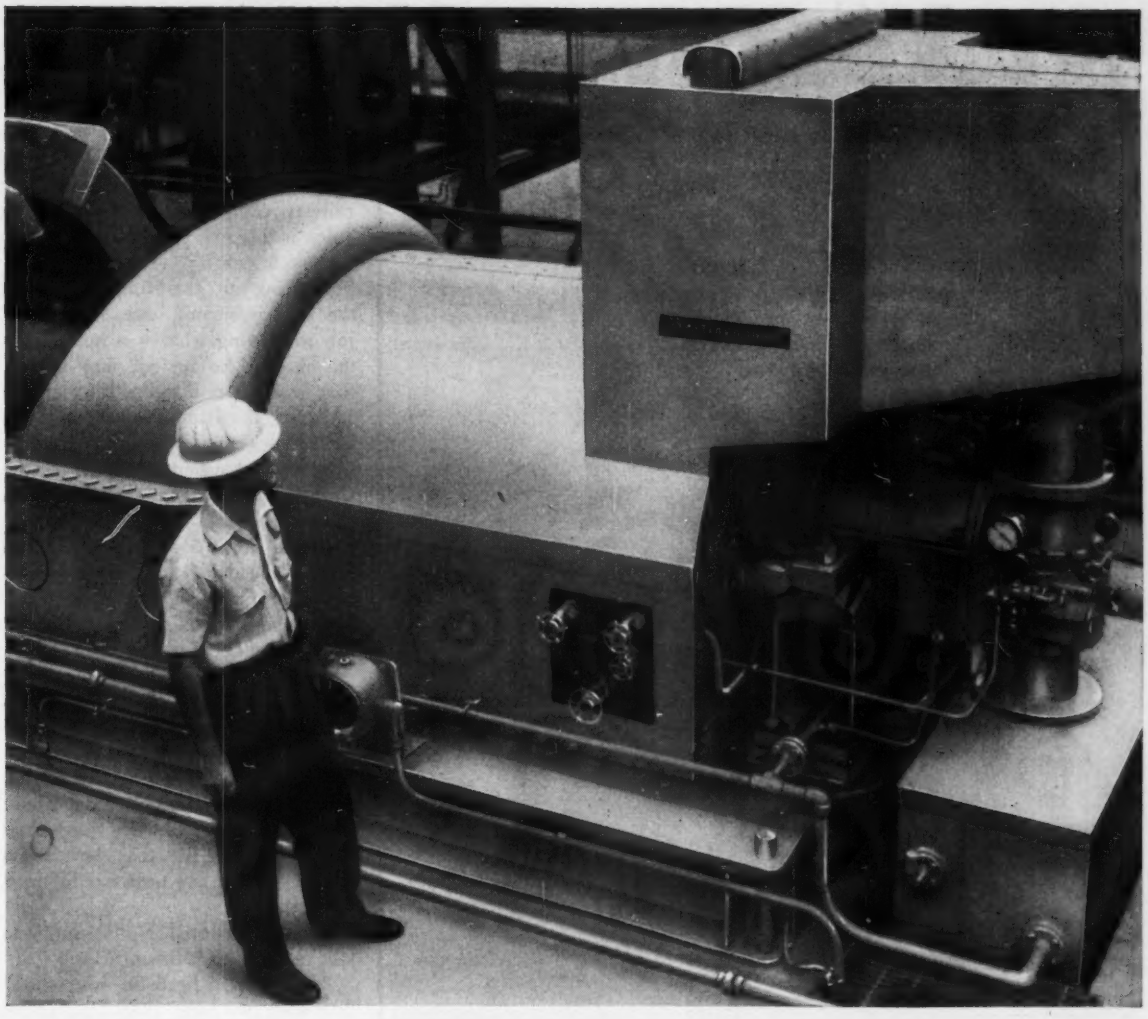

Westinghouse multi-stage, hi-speed turbines guarantee you

...engineered power to meet your exact needs

Why pay for power you can't use? Or, by the same token, why strain a machine beyond its capability? Westinghouse can meet your exact turbine requirements with the world's broadest line of wheel sizes and design capabilities for steam conditions through 2400 psig—1050° F at the throttle, exhausting from 1 in.hg absolute to 300 psig.*

Fitting the right wheel size to the job is the key to efficiency and economy. By knowing your process requirements, cost of steam and number of hours you expect your turbine to run during the "payoff" period, we can provide the turbine design best suited to your power and economic requirements.

To meet these varied requirements, Westinghouse has available five frame sizes of multi-stage, hi-speed turbines with wheel diameters ranging from 12 in. to 32 in. In addition, interchangeability of many wearing parts saves you money on inventories and stocking of spare parts.

Westinghouse turbine specialists located throughout the country are available at all times to provide personal attention to your heat balance problems, and are equipped to offer on-the-spot price and performance data for this entire turbine line. The capabilities of the world's largest and most modern small turbine facility are at your disposal. Call your Westinghouse representative, or write Westinghouse Electric Corporation, Small Turbine Sales, Lester Branch Post Office, Philadelphia 13, Pennsylvania. J-50605

***WESTINGHOUSE MULTI-STAGE, MULTI-VALVE, HI-SPEED TURBINE FRAME CAPABILITIES**

Turbine Frame	M-12	M-16	M-20	M-25	M-32
Number of Stages	As Required				
Wheel Size, in.	12½	16	20	25	32
Maximum hp	4000	5000	7000	10,000	16,000
Maximum rpm	16,000	12,500	10,000	8000	6000
Maximum P_1, psig	1500	1500	1500	1500	1500
Maximum T_1, °FIT	950	950	950	950	950
Maximum P_2, psig	300	300	300	300	50
Exhaust Size, in.	20	24	30	36	48
D. F. Exh. Size, in.	30	36	48	42 x 64½	48 x 84
Max. Inlet Size, in.	5	6	8	10	12

(For special applications, inlet steam conditions to 2400 psig, 1050° F total temperature can be accommodated.)

YOU CAN BE SURE...IF IT'S

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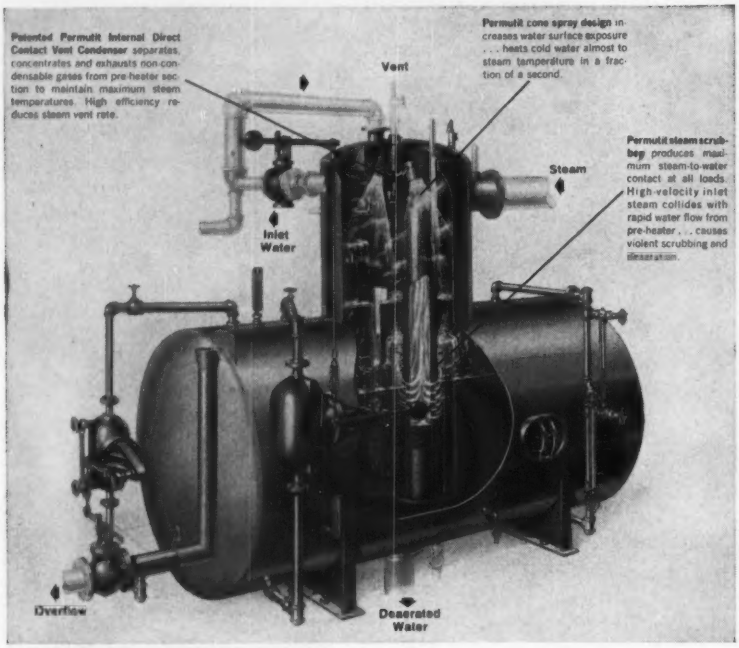
is a Pfaudler Permutit program providing
the know-how
the equipment
and the experience
for solving problems involving fluids.


Patented Permutit Internal Direct Contact Vent Condenser separates, concentrates and exhausts non-condensable gases from pre-heater section to maintain maximum steam temperatures. High efficiency reduces steam vent rate.
Vent
Permutit cone spray design increases water surface exposure . . . heats cold water almost to steam temperature in a fraction of a second.
Steam
Permutit steam scrubber produces maximum steam-to-water contact at all loads. High-velocity inlet steam collides with rapid water flow from pre-heater . . . causes violent scrubbing and deaeration.
Inlet Water
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New deaerators guarantee less than 0.005 ml/l oxygen at all loads

This is the new Permutit Type B Deaerator. Both horizontal and vertical designs hold oxygen to 0.005 ml/l at all loads up to a peak of 150,000 lbs/hr.

No trays to be removed or cleaned. Tubeless internal vent condenser eliminates tube cleaning, also.

30,000, 50,000, and 70,000-lbs/hr horizontal units are available from stock. They come as packaged units with all internals, including sprays, completely assembled. Pre-fitted float-cage and gauge-glass piping further simplify installation.

Capacities from 150,000 to as much as 3,000,000 lbs/hr are available in Permutit Type A Deaerators.

For more information, write to our Permutit Division, Dept. PO-89, 50 West 44th St., New York 36, N.Y.

Fluidics covers such varied phases of fluid handling and control as:

corrosioneering	drying
water treatment	blending
waste treatment	metering
reactions	valving
ion exchange	piping
gas analysis	pumping
agitation	storing

Whenever you have a fluid-handling problem, look to this Pfaudler Permutit FLUIDICS program for the best solution.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

Marmaduke

Continued from page 150

crisis, he slumped in his seat and busted out bawling like a baby. Then he got sore and started cursing the railway company at the top of his voice with some of his choicest two-bit cuss words.

"During all this time his uncle, the superintendent, was at the new job wondering what was holding up the shovel. So he got into his tin lizzy and set out across town to see for himself. At first he thought the new boiler might be giving Hollis trouble. But when he got past the Chateau Laurier in the downtown section, he ran into a traffic jam. Then he saw his shovel parked two blocks ahead, along the curb, surrounded by traffic and pedestrians. His nephew had his audience all right, no question about it.

"When the super got the story from his nephew and learned of all the damage that his firm would have to pay he was sore as a boiled lobster. He lit into Hollis and told him that he evidently learned everything about shovel operations but one thing. And that was to take his stack down when crossing street car tracks with overhead trolleys.

" 'But,' protested Hollis, 'no one told me to take it down.'

" 'You got a head on your shoulders with two ears,' roared his uncle. 'Why in hell don't you try listening instead of yapping?'

"Next morning Hollis was demoted back to me as fireman. That's when I quit. Two days later I was sailing out of Toronto in the engine room of a laker. I couldn't be bothered working with a wise guy who knew so much he couldn't listen while I tried to help him."—*SME*

Marmy's Mailbox

MARMY TOO KIND

Surprised in "Marmy's hot tomatoes," Dec '57, that the old consulting engineer didn't throttle the feed pumps without telling anyone. Then he could have had some fun letting them guess what he had done. But congratulations to the old swashbuckler and operating engineer. May he live forever.

C G HOWARTER, *Canton, Ill.*

For more facts circle 297 on Reader Service card, p 97

circle 298 on Reader Service card, p 97 ➤

ONE OF THE GARLOCK **2,000**

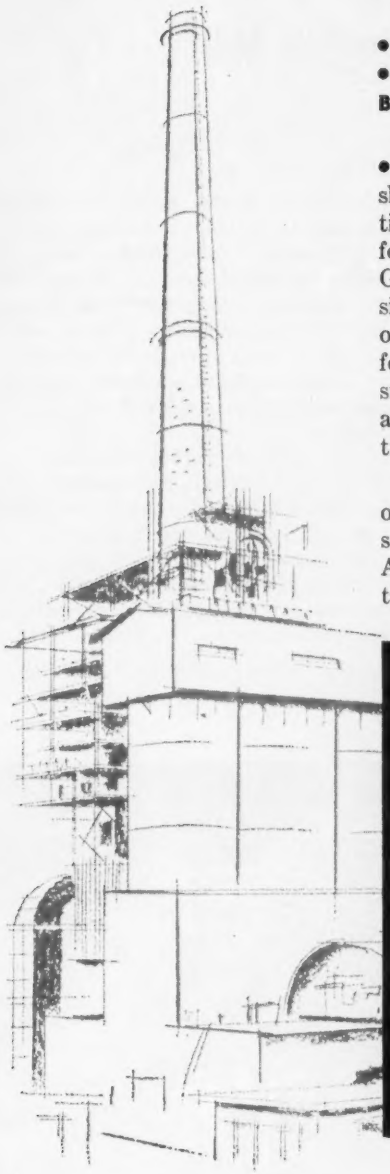
IT'S GOOD PIPING PRACTICE TO USE

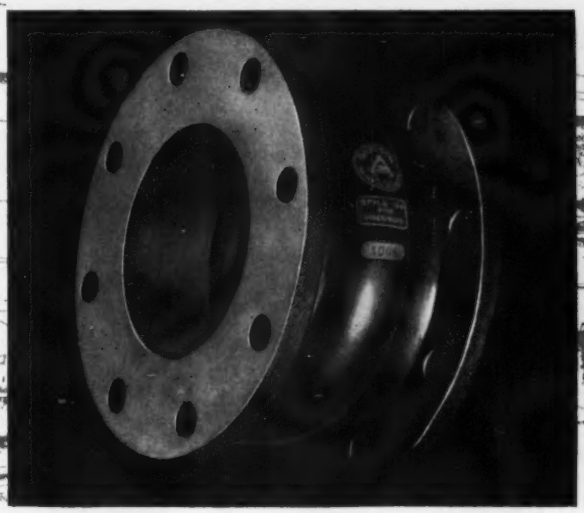
Garlock Rubber Expansion Joints

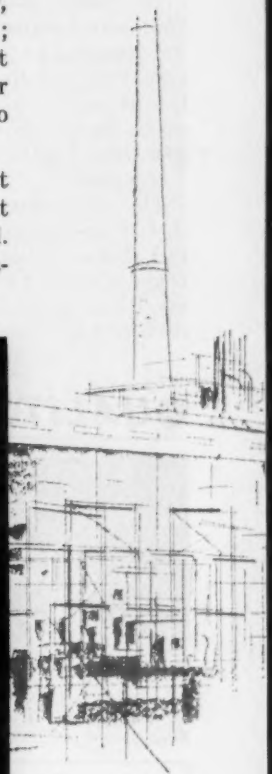
• Prevent Stresses • Eliminate Vibration, Noise • Compensate for Misalignment • Reduce Flange Breakage

• Garlock All-Rubber Expansion Joints react to the slightest pressure . . . provide complete piping protection at all times. Moreover, they are internally reinforced with steel rings to assure greater strength. Garlock spool type rubber expansion joints are made in sizes ¾" to 84" inside diameter; in round, rectangular, offset, multiple arch, concentric and eccentric tapered; for use against water, oil, mild acids, gases, and exhaust steam. "U" type expansion joints are available for applications ranging from lightweight equipment to turbines.

Rubber Expansion Joints are another important part of "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. Ask your Garlock representative for his recommendations, or write for Catalog AD-137.







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Republic ELECTRUNITE Boiler Tubes

and black liquor fuel . . . produces dependable power at INTERNATIONAL PAPER'S Springhill Mill

Dependability is important to maintaining production at International Paper Company's Southern Kraft Division at Springhill, Louisiana. Republic ELECTRUNITE® Boiler Tubes were used in the construction of their new power plant.

The boiler installation, designated as an EE Recovery Unit, was designed and manufactured by Combustion Engineering, Inc., New York City, and installed by International Paper's Engineering Department. Designed to produce an average of 226,000 pounds of steam per hour at an operating pressure of 850 psig, 825°F. The boiler drum is designed for 1,000 psig.

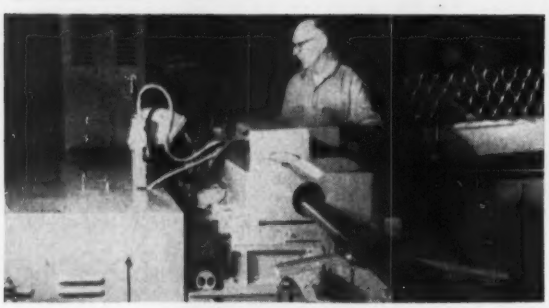
This boiler has a very large furnace and high heat surface necessary to satisfactorily burn black liquor fuel used to produce waste heat and recover valuable chemicals which are reused in the pulp making process. Black liquor fuel is sprayed into the furnace and the boiler is capable of burning 1,500,000 pounds of dry solids every twenty-four hours.

Republic ELECTRUNITE Boiler Tubes are able to withstand tremendous temperatures because dependability and quality is built-in. ELECTRUNITE is produced from highest quality flat-rolled open-hearth steel and manufactured by Republic's exclusive process that ELECTRically-UNITEs the tube under pressure without additional foreign or extra metal. Full normalizing and this process assures uniform wall thickness and diameter, uniform ductility, easy workability, and in-service dependability.

Each length of ELECTRUNITE Boiler Tube is hydrostatically or electronically tested to conform with applicable ASTM specifications, the ASME Boiler and Pressure Code, as well as local, state, and boiler insurance requirements.

To learn more about ELECTRUNITE for boiler, heat exchanger, condenser, or evaporator applications, call your Republic representative. Or, write.

QUALITY YOU CAN MEASURE . . .



FARROWTEST REJECT TABLE

Wall Thickness (B.W. Gage)	Minor dimension of the defect (Length or Depth)	Defective Area (Length, Depth Plane)
20	.006"	.0025 sq. inches
18	.006"	.003 sq. inches
16	12½% of wall	.003 sq. inches
14 and 13	12½% of wall	.004 sq. inches
12 and heavier	12½% of wall	.005 sq. inches

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

REPUBLIC ELECTRUNITE STAINLESS STEEL HEAT EXCHANGER TUBING resists corrosion and provides long trouble-free service for main surface condensers in utility power plants where water is used directly from natural sources. If you have a water problem, call your Republic representative.

FARROWTEST®—QUALITY YOU CAN MEASURE. Not a laboratory theory, not a mere inspection tool, but an exclusive production test that detects and rejects tubing containing defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with the table, left, at no extra cost.

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Please send more information on the following products:

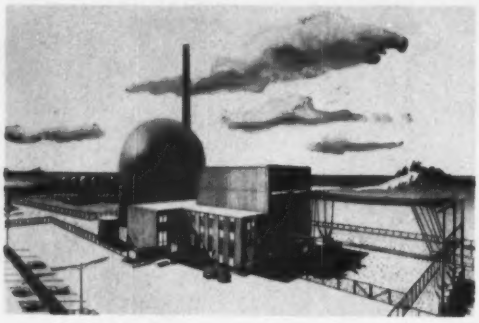
☐ Republic ELECTRUNITE Boiler Tubes
☐ Republic ELECTRUNITE Heat Exchanger Tubes
☐ Carbon ☐ Stainless ☐ FARROWTEST Brochure

Name_____ Title_____
Firm_____
Address_____
City_____ Zone_____ State_____

For more facts circle 299 on Reader Service card, p 97

Powerscope . . . A selective look at

A-plant construction, around the world



Artist's sketch, above, shows atomic electric plant to be built by Consumers Power Co on Lake Michigan at Big Rock Point. Reactor will be a direct-cycle forced-circulation boiling-water unit capable of producing 50,000 kw of electricity. It is scheduled for operation in 1962. Primary objective: development of engineering and economic data on high-power density and high specific power. GE will furnish nuclear part of the project.

A $60,000,000 atomic power station—exclusive of design and development costs—will be built by Atomic Energy of Canada Ltd, at a site yet to be determined. Known as CANDU (*Can*adian *D*euterium *U*ranium), the station will produce 200,000 kw, using a natural-uranium—heavy-water system.

First nuclear power plant to be shipped from U.S.S.R. to another country has been delivered to Czechoslovakia, reports McGraw-Hill World News. Installed capacity is 150,000 kw. It is world's first A-power plant using natural uranium. Carbonic acid is used as coolant instead of water.

Britain's fifth and largest nuclear power station will be world's first to use pump-storage system of conservation. The 550-mw station will cost an estimated $182 million, is slated for completion in 1964. It will have two improved Calder Hall type gas-cooled graphite-moderated reactors.

Nuclear superheated steam of 1000 F has been generated by heat from the Sodium Reactor Experiment (SRE), marking the highest steam temperature ever produced by heat from an atomic reactor. Molten sodium, the heat-transfer medium, reached 1060 F during the record power run. Sodium carries heat from the reactor core to a Southern California Edison Co steam-generating plant adjacent to the reactor. Data from the high-temperature operation has provided additional experience on the technical feasibility of the sodium-cooled graphite-moderated concept of economical atomic power.

General Electric boiling-water reactors have been chosen for the first nuclear power plants in both West Germany and Switzerland. The West German unit will be a 15,000-kw reactor for a nuclear power station being built by Allgemeine Elektrizitats-Gesellschaft, at Kahl, near Frankfurt. The Swiss BWR will be installed in a plant having an initial capacity of 15,000 kw of power—equal to 55,500 thermal kilowatts.

Pushbutton engineering

World's most advanced computer-automated steam-electric power generating units are scheduled to be completed by Southern California Edison Co late in 1960 at its Huntington Beach station. Two cross-compound steam turbine-generators will be added to existing facility, boosting overall capacity to 820,000 kw. Computer system will continuously scan 900 points, log 50 critical quantities each hour and identify and print out data from more than 300 alarm points. Info will be stored in a 16,000-word magnetic drum memory. Complete automatic hot and cold startup, normal and emergency shutdown and continuous control of boiler-turbine-generator systems are provided by the advanced electronic control system. Watch the pages of POWER for full station design and control details—in upcoming issues.

General Electric's large steam turbine-generator dept has unveiled a multimillion-dollar array of automated machine tools—all designed to help build steam turbine-generators with ratings from 50,000 to more than 500,000 kw. Many of the machines work entirely under the control of magnetic tape.

Before the well runs dry

Engineers must accept the challenge of making less water do more work in various manufacturing processes, warned General Motors' VP Robert M Critchfield. Speaking at a 2-day session on Industrial Water Conservation at the U of Michigan, he pointed out that most industries have "very good and usually expensive waste-treatment plants—which make sure that no toxic materials are discharged to the stream. . . ." But so far as water conservation and reuse are concerned, he added,

this month's power-field happenings

ART SOMMER, Assistant Editor

"we should look forward to further development of our industrial waste-treatment processes . . . we must learn to use water just as efficiently as we do other materials."

An electrodialysis process has been selected for the third of five saline-water conversion demonstration plants to be built by the U.S. Government. This plant will convert brackish water to fresh at a rate of at least 250,000 gallons a day. A bill, signed by President Eisenhower last Sept 2nd, authorizes spending of $10,000,000 for the program. Two of the five plants will desalt sea water, the others will treat brackish inland water.

A popular decision—overseas

U.S. decision not to object to imports of hydroelectric machinery from foreign countries on security grounds drew a highly favorable response in London. In hailing the decision as outstanding economic news, the *Daily Telegraph* added, "If, as seems reasonable to expect, a similar complaint against imports of steam turbines is rejected, it means that over an important sector of trade, competition and not disguised protectionism will be the ruling principle."

Westinghouse Electric Corp has offered to build for TVA the largest steam turbine-generator in existence. Unit would produce 800,000 kw of electric power, at capital cost to TVA for the machine of $30 per kw.

Two 47,368-kva generators are being supplied the U.S. Army Corps of Engineers' Bull Shoals Dam on the White River in Arkansas by Allis-Chalmers. Units represent a $1,796,432 award.

Westinghouse Electric Corp will build a 305,000-kw turbine-generator for Commonwealth Edison Co's Waukegan generating station, 30 miles north of Chicago. The unit, slated for delivery in July 1961, will up station's capacity to more than 1,000,000 kw. Bechtel Corp has been named engineer-constructor for the addition.

English Electric Co Ltd will supply two 200,000-kw steam turbine-generators valued at about $8.4 million to the electricity supply commission of New South Wales, Australia.

Electric Machinery Mfg Company will supply auxiliary motors for newest expansion at Florida Power Corp's Paul B Bartow power plant. The motors will drive forced-draft, induced-draft and recirculating fans. Boiler-feed pump and condensate pump drives are included. The addition, when completed in 1961, will generate 120,000 kw. Existing generating capacity of FPC is 775,000 kw.

The Army Engineers have awarded a contract for eight large power generating turbines to English Electric Export and Trading Co, Ltd. The turbines, each rated at 90,300 hp, will be installed at the Big Bend civil works project in South Dakota. Most of the manufacturing work on the turbines will be done for English Electric in the Scarborough, Ontario plant of John Inglis Co. The English Electric bid of $6,512,313 was reported to be about 30% below lowest U.S. bid.

United States is lending $9,000,000 to Communist Yugoslavia for a thermal power plant. The plant, with capacity of 72,500 kw, will be built in Krusevac in southern Serbia, an area containing lignite deposits.

Two contracts, involving multimillion-dollar programs to control air pollution by open-hearth furnace gases, one at a major steel plant in the U.S. and the other at a similar plant in Italy, have been awarded to Koppers Company, Inc.

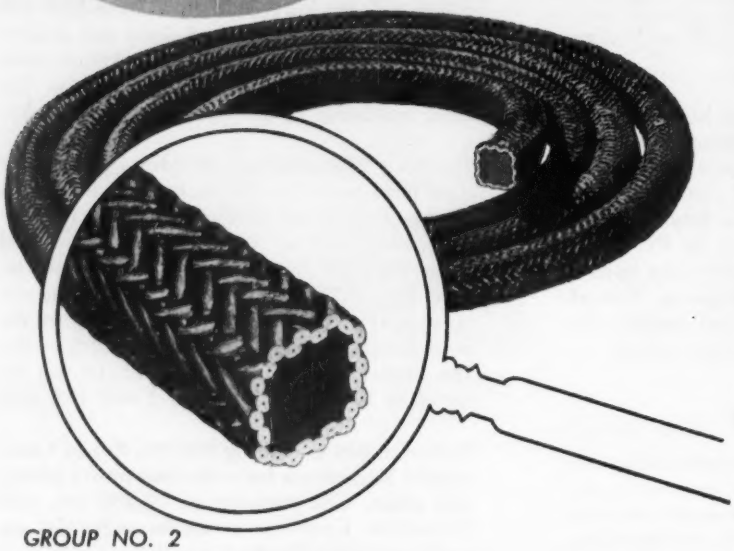
Pushbutton engineering

Four out of five scientists and engineers now oppose collective bargaining for themselves, a newly published U of Michigan study indicates. Fields covered include mechanical, electrical, chemical, civil, electronic and automotive engineering. Among those favoring some form of collective action, about half spoke in terms of action by their professional societies, while the rest thought more in terms of conventional labor union activity.

What is an engineer? How do I become an engineer? What do engineers do? Is there a difference between an engineer and a scientist? These are a few of the many questions being asked by high-school students interested in engineering or science as a career. To calm their bewilderment a "big brother" approach has been adopted by a group of professional New Jersey engineers and scientists. They travel throughout the state speaking to students and telling them the facts about embarking on a career in which they themselves have achieved success.

MOST COMPLETE LINE

Eleven Product Groups Serve Every Sealing Need



GROUP NO. 2

Steam Valve Packings

FOR TEMPERATURES TO 1000°F, PRESSURES TO 1500 PSI

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3. Rotary Pump Packings & Seals
4. Criss-cross Braided Packings
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11. Expansion Joints

Belmont 4041 Steam Valve Packing is the answer to sealing valve stems against superheated steam temperatures as high as 1000° F. Also ideal for expansion joints.

Inconel wire-inserted asbestos is braided over a non-metallic plastic core to combine rugged strength for high pressures with compressibility for good sealing characteristics.

Supplied square in cross section in sizes 3/16" and up.

Ask your Belmont distributor or write for the name of one nearest you.

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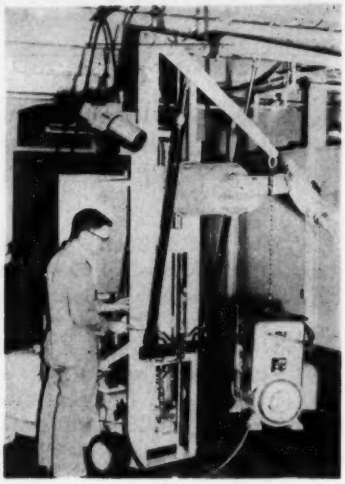
Reports from the field



Robots team up for nuclear maintenance work

Capable of threading pipe or lifting 1000 lb, largest of a 6-"man" robot fleet is 3-armed, 3-ton, and 8-ft tall. Robots respond to sound, performing many quasihuman functions for Babcock & Wilcox Company's Atomic Energy Division where radiation makes it too "hot" for people.

Robots were designed as part of a facility to develop prototypes of equipment for circulating-liquid-metal reactors. The fleet will be remotely controlled by radio signals from a "master-brain" control console. Closed-circuit TV system lets operator watch the work area.

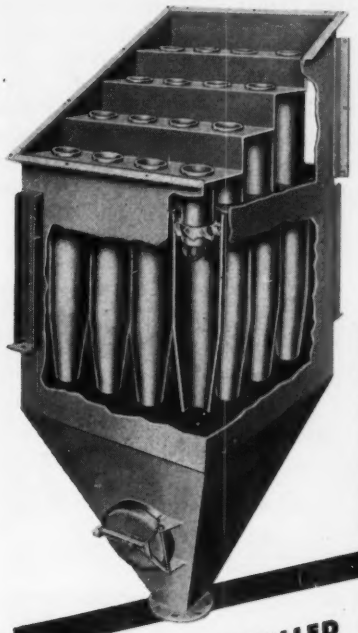
Most complex robot, above, has one arm capable of duplicating human wrist and arm functions. Two auxiliary arms can lift a small wrench or a 1000-lb object. Other units are a tow truck, a pipe welder complete with TV examination "eye," a pipe cutter and a 50-ton capacity crane.

Nuclear power in Europe now first goes commercial

PARIS (*McGraw-Hill World News*)—First commercial production of nuclear power in continental Western Europe began recently when reactor G-2 at Marcoule, France started feeding electricity into the French distribution network.

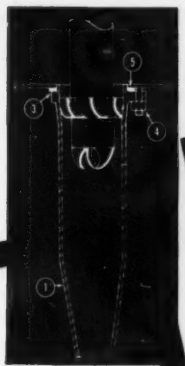
The French AEC announced that

13 BIG REASONS WHY MULTICLONE FLY ASH COLLECTORS



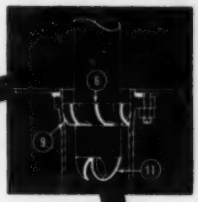
✔ COST LESS TO MAINTAIN...
✔ ARE FAR SIMPLER TO SERVICE!

When you buy fly ash collection equipment, don't stop with a comparison of *initial* cost only. Compare also the cost and simplicity of keeping your collector at top-notch efficiency *throughout the years.* To the outstanding advantages of Multiclone's unique operating features, add the low cost and easy maintenance of this equipment and you'll see why Multiclones are the leading choice wherever *centrifugal* types of fly ash collectors are the most practical solution.



EASILY INSTALLED COLLECTING TUBES

1. **CAST IRON TUBES** assure long wear!
2. **SPECIAL ALLOY TUBES** (FBA Inco #40, Chromehard and Ni-Hard) can be supplied where high temperatures or severe erosion are problems!
3. **TUBES ARE PRECISION-CAST** for exact fit into tube sheet. Tube lip protects sealing gasket!
4. **TIGHT LEAKPROOF FIT** of each tube is maintained indefinitely by special lock nuts!
5. **GAS-TIGHT JOINT** between tube sheet and each tube is assured by special gasket. Joint can be easily renewed when replacing tube!



PRECISION CAST VANES!

6. **CAST IRON VANES** resist erosion!
7. **SPECIAL ALLOY VANES** (FBA Inco #40, Chromehard and Ni-Hard) can be supplied where high temperatures or severe erosion are problems!
8. **VANES ARE EASILY INSTALLED** by simply dropping new ones into place when changing collecting tubes!
9. **EXACT FIT OF EACH VANE** in the tapered collecting tube prevents erosive "blow-by"!
10. **CAPACITY AND EFFICIENCY** of the unit can be quickly altered by simply changing vanes. Assures easy adaptability to new operating requirements—big savings in plant modernization programs!
11. **SPIROVANES** (energy recovery devices) may easily be added to outlet tubes of existing installations to increase capacity or reduce pressure drop!

Plus These Important Advantages...

12. **CUBIC SHAPE** of Multiclone is easier to install and insulate — and requires only ONE simple inlet and outlet duct!
13. **BACKED BY OVER 3300 INSTALLATIONS** serving a wide cross-section of industry, each Multiclone benefits from the unequalled "know-how" gained during Western Precipitation's half-century of leadership in the highly-technical field of modern fly ash collection!

Compare the above advantages with any competitive equipment and you'll readily see why Multiclones are the logical choice for *your particular* operations, too. There's a Multiclone representative near you who will gladly supply further details to fit your individual requirements. No obligation, of course!

Send for descriptive literature on Multiclone equipment.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
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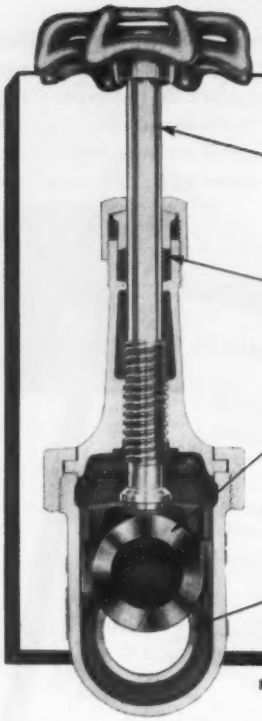
Outstanding Valve performance with

KENNEDIZED DISCS

an entirely new development in bronze gate valve construction that extends service life beyond comparison . . .



PROVEN BY USE!

KENALLOY STEM . . .

Exclusive KENNEDY alloy that prevents dezincification and corrosion and provides smooth, non-galling threads and bearing surfaces. In a rugged use test, this stem withstood a mechanical loading of 18 foot-pounds closing torque and after 25,000 cycles was like new!

PACKING . . .

New type packing made of molded graphite asbestos with a Buna "N" binder required no replacement during or after 25,000 cycles.

KENNEDIZED DISC . . .

In punishing use tests, the super mirror finish of the KENNEDIZED disc actually improved with wear! Disc showed no galling or other wear marks after 25,000 cycles at 150 lbs. saturated steam pressure. This remarkable wear resistance is combined with an extremely low coefficient of friction, smooth sliding properties, excellent anti-seizure characteristics and corrosion and galling resistance. Tests and in-use results prove these discs set a new and unmatched high standard in valve performance.

SEAT . . .

Due to the low coefficient of friction and smooth sliding properties, the action of the KENNEDIZED disc actually improved the finish on the seat. Here, again, no galling was found on the seat after 25,000 cycles.

For the complete KENNEDIZED DISC story, write for Bulletin 574.

Fig. 525KD
125-Pound S.W.P.
Bronze Gate Valve.

KENNEDIZED DISCS NOW AVAILABLE IN THESE KENNEDY VALVES . . .

FIG. 427KD
125-Pound S.W.P. Bronze Gate Valve—Non-Rising Stem, Inside Screw, KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs.; W.O.G., Non-Shock, 200 lbs.

Fig. 525KD
125-Pound S.W.P. Bronze Gate Valve—Union Bonnet, Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs., W.O.G., Non-Shock, 200 lbs.

Fig. 78KD
200-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3"; Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 200 lbs.; W.O.G., Non-Shock, 400 lbs.

Fig. 518KD
300-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3"; Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 300 lbs.; W.O.G., Non-Shock, 600 lbs.

KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK

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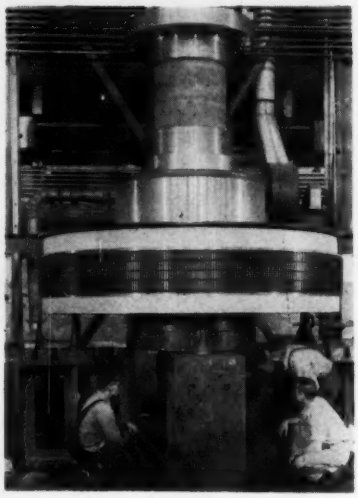
reactor went on the line with a thermal output of 130,000 kw, electrical output of 9000 kw. Full power output will be 150,000-kw thermal and 25,000- to 30,000-kw electrical.

G-2 was built primarily to produce plutonium. It is fueled with natural uranium moderated with graphite, cooled with CO_2 gas under 12 atmospheres' pressure.



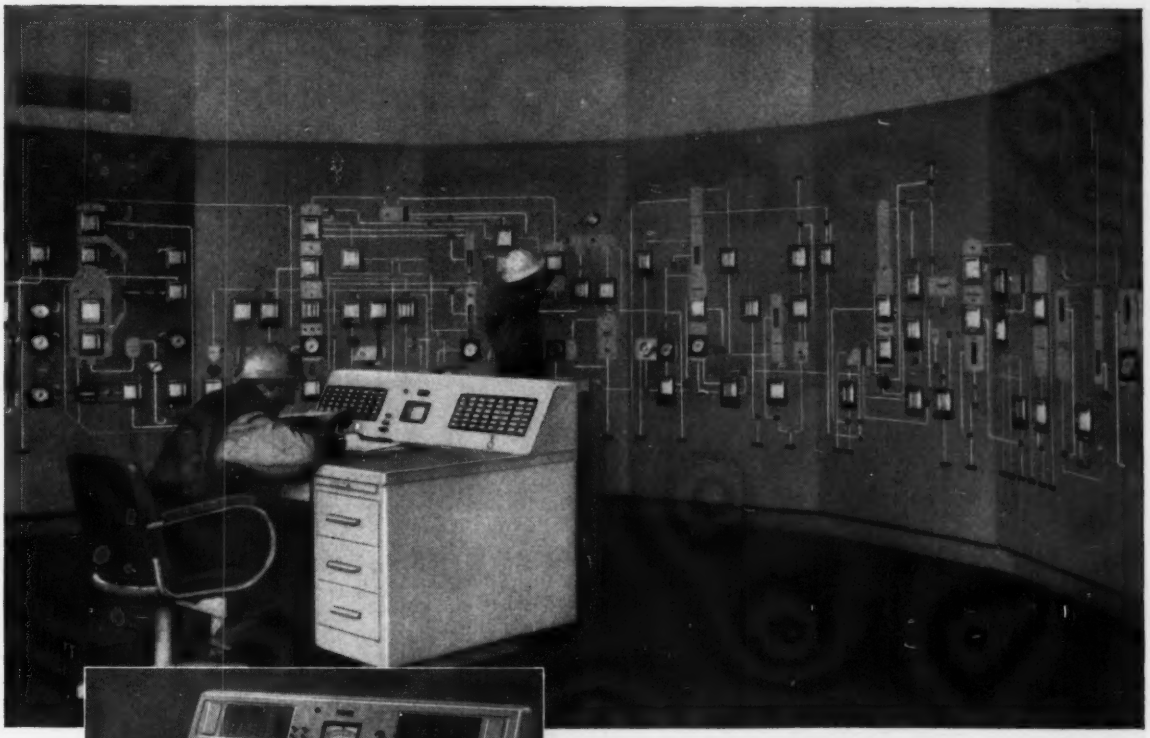
Mammoth electrical parts power magnetic bottle

In the controlled thermonuclear power project under way at Princeton, N. J., this 130-in. shaft will be part of a 5-machine laminated flywheel motor-generator set for the Model C Stellarator.

Complete motor-generator sets will be over 70-ft long and have bearings with 28 to 34-in. diameters. This shaft weighs 32,000 lb, has a coupling diameter of 53 in.; a 40-in. diameter where the 124-in. diameter armature is pressed into place. It was built by the Allis-Chalmers Manufacturing Company.

Georgia hydro station begins operations

Located on the Chattahoochee River near Columbus, Ga., Georgia Power Company's Oliver Dam hydro station has installed generating capacity of



Read up to 288 temperatures at this Honeywell "Operator's Desk"

This compact console type Operator's Desk makes it possible, from one central location, to read as many as 288 thermocouple points, or 192 points with identifying card holders. Its *ElectroniK* Precision Indicator and switch assemblies are mounted for ease of reading whether the operator is sitting or standing.

The *ElectroniK* Precision Indicator, accurate to 1/5 of 1% of full scale, can be of single range, double range or extended range type. Use it with all types of thermocouples, millivolt actuation, or a combination of the two. The desk can be supplied with a telephone dial system for thermocouple selection, rather than key or pushbutton switches. Additional equipment such as lights and clocks can be built in.

Servicing is simplified. Instrument and switch terminal blocks are in the lower rear portion of the desk, readily accessible from the back of the console. All wiring enters from the bottom of this compartment.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

First in Control

For more facts circle 303 on Reader Service card, p 97

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The new W-S TeeLet replaces conventional Tees of cast or malleable iron, welded or forged steel . . . requires fewer stock sizes. Available in sizes from ⅛ to 1½" IPS, TeeLets are fully machined from forging quality solid steel bars and adapt to run-pipe sizes to 36". They require no additional joint strength calculations for any ASTM A-53 or A-106 Grade B run-pipe of Schedule 40 or 80.

What about cost? A size-by-size comparison with conventional Tees shows TeeLets average less than 50 per cent of the cost you now pay. A W-S TeeLet, with screwed, socket-weld or butt-weld ends, requires no shaping, fitting, beveling or extra alignment. You can connect to the run-pipe at any point. Short heights mean easy inspection of the attachment weld or back-weld, if desired.

A W-S TeeLet costs less to buy, less to install than anything you can buy or make. For complete information, prices, and names of distributors, write: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

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H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Copper and Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

Reports from the field

Begins on page 158

60,000 kw, predicted annual generation of 255 million kwhr. Plant is designed for completely automatic, remote-controlled operation.

The run-of-river plant is integrated with existing dams at Bartletts Ferry and Goat Rock River upstream and North Highlands downstream. Dam is made of concrete, with a 1324-ft-long spillway. It has 33 radial gates, nonoverflow sections 499-ft long, an intake section 198-ft long, and rises about 80 ft above river bed at the headworks.

The powerhouse has two floors, a generating room at an elevation of 286 ft and an outdoor deck over the generating floor at 299 ft. Installed capacity is 84,700 hp, from three turbines of 25,400-hp capacity, one of 8500 hp.

Calendar of Events

Aug 9-12—American Society of Mechanical Engineers and **American Institute of Consulting Engineers,** Heat-Transfer Conference. University of Connecticut, Storrs, Conn. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Aug 23-26—American Institute of Electrical Engineers, 6th Electrical Conference of the Petroleum Industry. Wilton Hotel, Long Beach. Details from L W Swanson, C F Braun & Co, Alhambra, Calif.

August 27—Illinois State Chamber of Commerce, Water Resources Committee: Water Supply Conference. Abraham Lincoln and St. Nicholas Hotels, Springfield. Details: Illinois State Chamber of Commerce, 20 N Wacker Drive, Chicago 6, Ill.

Sept 7-11 — Illuminating Engineering Society, National Technical Conference. Fairmont and Mark Hopkins Hotels, San Francisco, Calif. Details from IES, 1860 Broadway, New York 23, N. Y.

Sept 17-18—American Society of Mechanical Engineers, Engineer-

For more facts circle 304 on Reader Service card, p 97

Choice of the leaders: K&M high-pressure insulations

Where temperatures range up to 1350°F., you'll find leaders in all fields where heat control is important turning to "K&M" KaytherM. Because they can be *sure* with "K&M" KaytherM. There's no better insulation of its type. In low-pressure insulations, it does everything "85% Magnesia" does, and does it better. Composed of diatomaceous silica and quality asbestos fibers, "K&M" KaytherM is easily worked on the job, chemically stable, strong, and lightweight. Cement adheres readily.

"K&M" also manufactures a full line of Low-Pressure Insulations in pipe, sheet, and block forms, as well as in cements for all types of applications.

Whatever your insulation problems, you can rely on the eighty-five years of asbestos engineering that lies behind every "K&M" asbestos product.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K·M
BEST IN ASBESTOS

For more facts circle 305 on Reader Service card, p 97

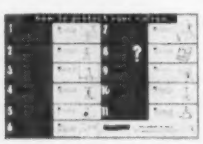
Choose R-P&C cast steel valves in 7 pressure classes (150 lb. through 2500 lb.) for dependable strength and quality

• R-P&C Cast Steel Valves—with primary ratings of 150 lbs., 300 lbs., and up to 2500 lbs.—are ideally suited to the high-pressure, high-temperature demands of the petroleum industry and of steam power plants. Here are some of the reasons:

STRENGTH • The design of R-P&C Cast Steel Valves embraces ample metal walls which exceed Code specifications. All components are designed and built to assure that valves conform to A.S.A. and A.P.I. requirements.

QUALITY • Castings for Steel Valves are made in R-P&C's own foundry. They are produced under direct supervision and control of R-P&C technical personnel. These castings are subject to critical inspection. R-P&C's inspection facilities embody latest methods of non-destructive testing—including a 2-million volt X-Ray machine for the internal examination of High Pressure valve castings.

DEPENDABILITY • R-P&C Valves are carefully assembled to assure proper fit of all parts and good mechanical operation. They are individually tested to fully conform to specifications or Codes as required. No valves are released from production until they have completely and satisfactorily met inspection and test requirements.



SEND FOR FREE WALL CHART

"How to Protect Your Valves"
This 22" x 17" chart gives valuable installation pointers, operating tips, clues to longer service life. For free copy, write us at Reading, Pa.

R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

Reports from the field

Begins on page 158

ing Management Conference. Statler-Hilton Hotel, Los Angeles, Calif. Details from ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Sept 21-25 — Instrument Society of America, 14th Annual Instrument - Automation Conference and Exhibit. International Ampitheater, Chicago, Ill. Details: H S Kindler, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

Sept 22-24—Armour Research Foundation and **Nucleonics Magazine,** with cooperation of AEC, Third Industrial Nuclear Technology Conference. Morrison Hotel, Chicago. Further details from L Reiffel, Co-chairman, ARF, Technology Center, Chicago 16, Ill.

Sept 28-Oct 1 — American Society of Mechanical Engineers and **American Institute of Electrical Engineers,** 1959 National Power Conference. Muehlebach Hotel, Kansas City, Mo. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Oct 6-9—Stanford Research Institute, International Symposium on High-Temperature Technology. Asilomar Conference Grounds. Details from Stanford Research Institute, Menlo Park, Calif.

Oct 20-22—American Society of Mechanical Engineers and **American Society of Lubricating Engineers,** Lubrication Conference. Sheraton-McAlpin Hotel, New York City. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Oct 27-29—American Society of Mechanical Engineers and **American Institute of Metallurgical Engineers,** Solid Fuels Conference. Cincinnati, Ohio. Details from ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Oct 28-29 — Armour Research Foundation of Illinois Institute of Technology, Computer Applications Symposium. Morrison Hotel, Chicago. Details from M J Jans, ARF, 10 W 35th St, Chicago 16, Ill.

For more facts circle 306 on Reader Service card, p 97

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

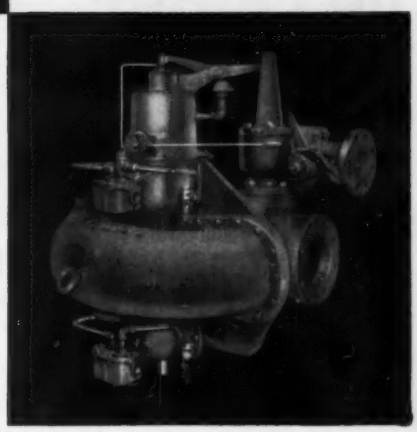
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



TT-1210

MAXIM MEANS EFFICIENT HEAT RECOVERY PLUS RESIDENTIAL TYPE SILENCING

In a single packaged unit, Maxim Heat Recovery Silencers do the job of both boiler and silencer. This saves the cost of installing two separate pieces of equipment, conserves valuable space, and minimizes back pressure.

Because Maxim equipment operates either wet or dry, your diesels can run continuously even if waste heat is used only intermittently. Highly efficient for recovery of waste heat, Maxim Heat Recovery Silencers combine this with the optimum in noise suppression—of special importance in populated areas.

Maxim offers the most complete line available—vertical and horizontal models for a wide range of conditions and capacities. Send coupon for full information.

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BOX 216, HARTFORD 1, CONN.

EMHART

60

Emhart Manufacturing Company
Maxim Division
Box 216, Hartford 1, Conn.

Please send bulletin on Maxim Heat Recovery Silencers.

name

company

address

Appointments

Corporation changes

Borg-Warner Corp, Marvel-Schebler Products Div: A B Pulliam, president and general manager. **Mallory-Sharon Metals Corporation:** A R Zender, board chairman and chief executive officer.

Blaw-Knox Company, Fabricating, Engineering and Construction Group: G E Kopetz, vice-president and general manager. **Vitro Corporation of America:** Woodman Perine, vice-president. **Vitro Engineering Company:** S M Stoller, engineering vice-president.

Marsh Instrument Company: Bernhard Willach, engineering vice-president. **Panellit Service Corporation:** M B Lorig, vice-president and general manager. **Cutler-Hammer Inc:** P B Harwood, senior vice-president; E B Fitzgerald, engineering vice-president. **Cohu Electronics, Inc,** Kin Tel Div: R F Lux, manufacturing vice-president. **Sylvania Electric Products Inc:** Dr Herbert Trotter Jr, senior vice-president.

General sales manager

The Clark Manufacturing Company: W J Manthey, sales and marketing vice-president. **Alloy Steel Products Company:** R E Boller Jr, general sales manager. **Kaiser Aluminum & Chemical Sales, Inc:** R F Becker, conduit sales manager. **The Dayton Rubber Company,** Industrial Products Div: John Sly, assistant sales manager.

New district offices

Nuclear Consultants Corporation: West Coast Div and sales office at 1717 S Victory Blvd, Glendale 1, Calif.; Richard Dickey, general manager.

The Torrington Company: at 244-246 Walker St, SW, Atlanta, Ga.; Larry Paine in charge.

Calumet & Hecla, Inc, Wolverine Tube Div: at 7040 W Cullom Ave, Norridge 34, Ill. **The Dayton Rubber Company:** at 7726 Reinhold Drive, Cincinnati, Ohio. **Bailey Meter Company:** at 110 Halsted St, East Orange, N. J.; H C Wheaton, manager.

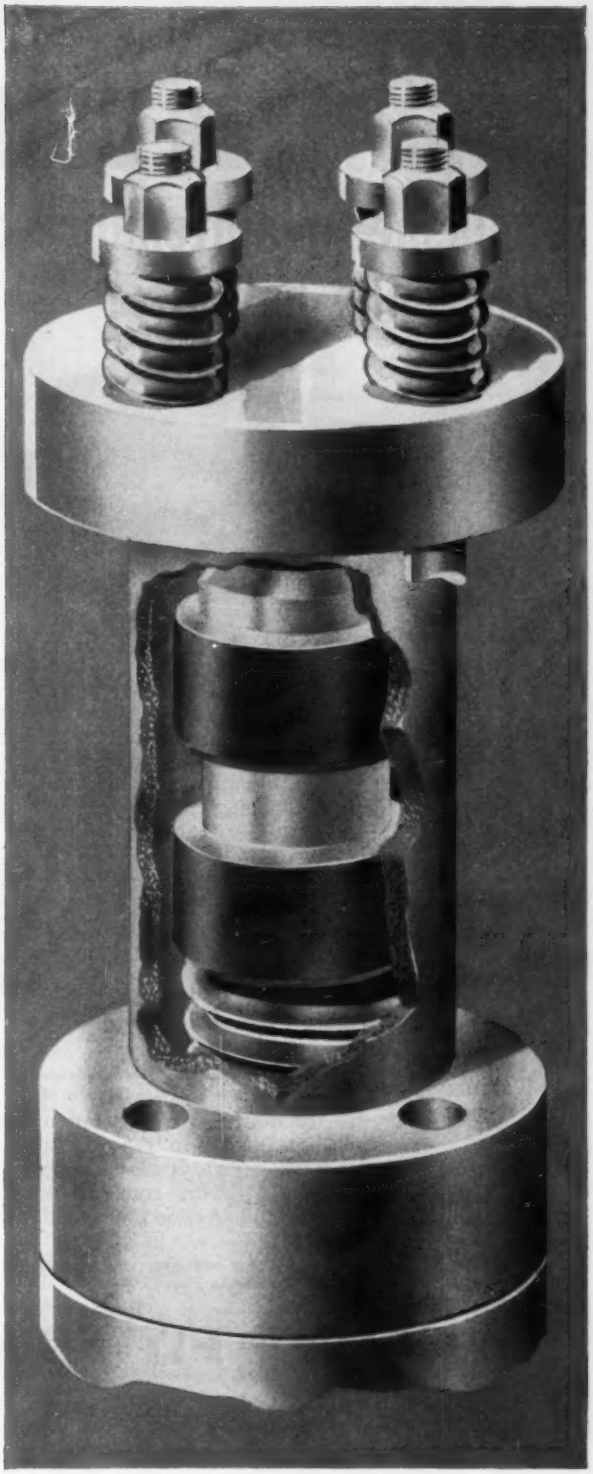
continued

NOW KOPPERS LEADS AGAIN

by bringing you lower precipitator maintenance and operating costs with

K-30*

bonded pistons on pneumatic vibrators



By eliminating the need for lubrication of the rapping mechanism in electrostatic precipitators, Koppers saves you many operational man-hours and maintenance costs.

This lubrication-free operation results from bonding a new wear-resistant material to vibrator piston surfaces. This special self-lubricating compound, identified by Koppers as "K-30," is composed of Teflon† and other wear-resistant materials that together provide a self-lubricated surface.

Most rapping mechanisms demand regular maintenance to be trouble-free, but "K-30" eliminates this need and provides more reliable operation.

Koppers research, backed by many years of experience in the electrostatic precipitation field will help you find the answer to your gas cleaning problems. Check with Koppers to learn how "K-30" can develop top efficiency in present or planned precipitator installations. For more information, write: KOPPERS COMPANY, INC., 6508 Scott Street, Baltimore 3, Maryland.

*Koppers Trademark

†E. I. duPont de Nemours & Company, Inc. trademark for tetrafluoroethylene resin

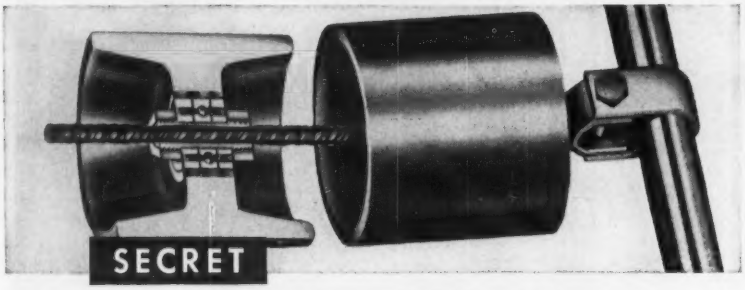
KOPPERS

ELECTROSTATIC PRECIPITATORS

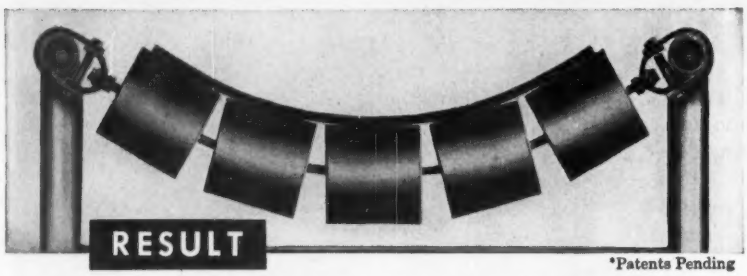
Engineered Products Sold with *Service*

For more facts circle 309 on Reader Service card, p 97

NEW (EXCLUSIVE WITH McNALLY PITTSBURG) CONVEYOR DESIGN ... slashes maintenance cost! ... extends belt life!



... of the amazingly improved efficiency of this modern belt conveyor is shown here. This new McNally Pittsburg Cradle Idler* consists of 5" rubber rollers assembled on precision ground ball bearings, prelubricated and lifetime sealed. Being a *true catenary* suspension with rollers mounted on flexible, *non-rotating* stainless steel wire rope, this design eliminates "loping" and dangerous harmonics.



*Patents Pending

... is greater capacity and faster belt operation with minimum spillage. Since the belt lies in true arc with no creases or bends to cause wear, *belt life is substantially increased.* Because this McNally Pittsburg conveyor design is so simple, costs are lower, and erection time is reduced.

WRITE TODAY | for details on the new conveyor which costs less to install . . . *saves money every day it is in use.*

McNALLY · PITTSBURG

McNally Pittsburg Mfg. Corp.
Dept. PO, Pittsburg, Kansas

☐ Please send information on the new McNally Pittsburg belt conveyor.

☐ Have Sales Engineer call for further consultation.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Appointments

Begins on page 166

District sales manager

Byron Jackson Pumps, Inc: Hugo Baldelli, southwest. **Union Asbestos and Rubber Company,** Fibrous Products Div: E W Vizard, midwest. **Crouse-Hinds Company:** J F Wueste, Washington State. **Narda Ultrasonics Corporation:** H A Frankel, New York State; Marvin Klein, midwest.

The Cooper-Bessemer Corporation: Earl Martin, Houston. **Allis-Chalmers Manufacturing Company:** G W Hanafee, Indianopolis. **Yuba Consolidated Industries, Inc:** J P Tepley, Seattle. **Clark Controller Company:** B C Harmon, Akron.

Recent purchases, mergers

Aerotec Industries, Inc: merger of The Aerotec Corporation, Prat-Daniel Corporation, The Aerotherm Corporation and The Thermix Corporation. **Fostoria Corporation:** planned merger of The Fostoria Pressed Steel Corporation, Chempump Corporation and Zenith Engineering Corporation. **Hupp Corporation:** purchase of valve-operator div of Cutler-Hammer, Inc. **Allis-Chalmers Manufacturing Company:** purchase of the Commercial Nuclear-Reactor Engineering Office, Washington, D.C., of ACF Industries, Nuclear Products-Erco Div. **Sylvania-Corning Nuclear Corporation:** will purchase a share in French nuclear-fuel company CERCA. **Schlumberger Ltd:** acquisition of 80% stock interest in Computer Systems, Inc.

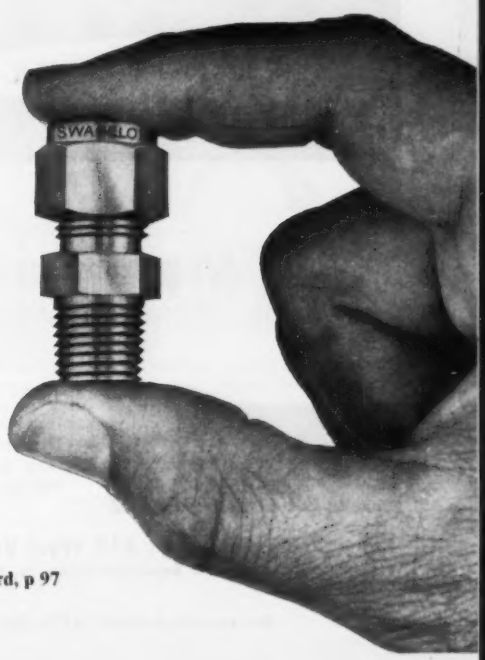
Institute elections

American Society of Mechanical Engineers, nominees: L Cisler, Detroit Edison Company, president; C H Coogan Jr, University of Connecticut; D E Marlowe, Catholic University of America; H N Muller Jr, Canadian Westinghouse Company, Ltd; W C Heath, Solar Aircraft Company; vice-presidents.

American Institute of Electrical Engineers: J H Foote, Commonwealth Associates, president; D L Greene, Gilbert Associates; J W Davis, Southern Bell Telephone and

Swagelok® engineers believe that NO fitting is too good if it keeps your plant in operation

A tube fitting is small in size but large in importance when you consider that the most minute leak in a system can cause the shutdown of a multi-million dollar plant. Swagelok Tube Fittings represent more than a mechanical necessity. **They are an investment in security**... the type of solid security which results from the use of the finest fittings assuring constant trouble-free, leak-proof operation.

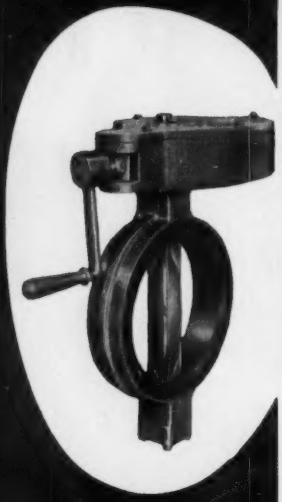


Crawford Fitting Company • 884 East 140th St. • Cleveland 10, Ohio
Crawford Fittings (Canada) Ltd., Niagara Falls, Ontario, Canada

For more facts circle 311 on Reader Service card, p 97

Never before has the Henry Pratt slogan "Creative Engineering for Fluid Systems" been more aptly proven as truth—for creativity and experience have combined with a most sophisticated result—the totally new MONOFLANGE MK-II.*

Stemming from four years of laboratory and field development, this compact and sensible valve will impress and delight those with a feeling for quality and economics.



The Monoflange MK-II is a versatile valve with a wide variety of sizes, materials, and operators—among which is the all new SIDEWINDER®, a totally enclosed manual operator designed to be the perfect mate for the MK-II.

We believe this is a significant contribution to the valving art—one which will establish a new trend in the low price field. You will want one to test for yourself.

Write for bulletin 10 K

Monoflange® MK-II
RUBBER SEAT BUTTERFLY VALVE

HENRY PRATT®

*Important things are happening at the Pratt Research Laboratories—as evidenced by this new product, the first of a series to be announced as part of the new line for 1960.

Henry Pratt Company, 319 West Van Buren St., Chicago 7, Illinois
Representatives in principal cities.

Appointments

Begins on page 166

Telegraph Co; M H Kight, US Bureau of Reclamation; G T Harness, University of Southern California; Dr Rene Dupuis, Quebec Hydro Electric Commission; F S Bacon, Gamewell Co; vice-presidents.

American Society for Testing Materials: F L LaQue, The International Nickel Co, president; M N Clair, The Thompson & Lichtner Co, vice-president.

Fluid Controls Institute, Inc: J R Lawler Jr, Lawler Automatic Controls, Inc, president; Fred Weldon, General Controls Co, 1st vice-president; Robert McCormick, Automatic Switch Co, 2nd vice-president.

Recent moves

Edgar J Kates, consulting engineer, diesel-engine specialist, has moved to 7 E 44th St, New York 17, N. Y.

Henry Pratt Company: to 319 W Van Buren St, Chicago 7, Ill.

Bailey Meter Company: Pittsburgh district office to 875 Greentree Rd, Pittsburgh 20, Pa.; Jacksonville office to 1143 Mary St, Jacksonville 7, Fla.

Obituaries

Stanley M Brown, 57, The Electric Storage Battery Company, Industrial Div, Philadelphia plant manager, on May 25th.

Fernand C Weiss, 67, retired engineering and construction vice-president and director of Alabama Power Co. on May 28th.

One ruble of every four spent by U.S.S.R. to develop industry in next seven years will go for power.

Coal surplus in 6-nation European Community, improved free-world oil outlook may reduce Euratom Commission's previous target of 15-million-kw nuclear generating capacity by 1967.

Lenin Prize, Russia's highest scientific order, went to engineers who designed a 126,000-kw kaplan turbine.

can save up to 40% on many pressure gauge applications

Analyzed your gauge needs lately—how much gauge performance you're getting, compared to what you need and what you pay for? Perhaps it's time for a closer look at United States Gauge with its line of 50,000 standard pressure gauges, plus specials (and all possible choices in case styles, sizes, materials and pressure ranges). For example, note how you can save up to 40% on premium gauges and still get premium performance with the USG A-Line *(top, right)*. Note, too, how you can get the exact gauge for *any* need and cut waste of under-buying or "over-gauging" . . . from all the gauge lines available at this one source. Then check the USG distributor listed in your Yellow Pages. Or write direct for catalogs and name of your nearest distributor today.

Paying needless premium prices for reliability? USG A-Line pressure gauges have premium construction, save up to 40% on premium prices. Meet A.S.A. Grade A standards, including 1% accuracy. Extra rugged, they are built to *deliver* longer under severe operating conditions, where you do not require the accuracy of Grade AA gauges, but where reliability and cost-cutting are "musts". Wide choice of Bourdon tubes, case styles and sizes, pressure ranges, and movements. You must see the sturdy design and price to believe the value and performance. Models for general-purpose service, altitude, refrigeration, ammonia and hydraulic applications. *Write for Catalog 305.*

Buying too much gauge for your purpose? Save with volume-priced, precision-built USG Drawn Case Gauges for service where your gauge need calls for A.S.A. Grade B standards, including 2% accuracy. *Write for Catalog 64A.*

Getting all the accuracy you're paying for? You can't buy more precision than with USG Test Gauges which meet or exceed A.S.A. Grade AA standards, including accuracy as high as 0.2 of 1%. *Write for Catalog 400.*

UNITED STATES GAUGE
Division of American Machine & Metals, Inc., Sellersville, Pa.

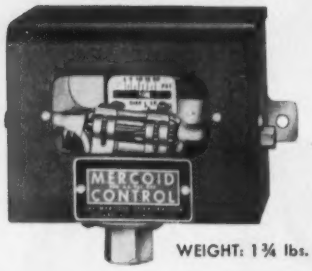
Find Your Nearest Distributor in the "Yellow Pages"

NEW

Small, Lightweight

MERCOID PRESSURE CONTROL

AP-153

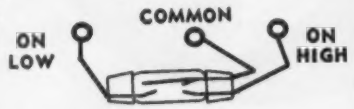


WEIGHT: 1¾ lbs.

FOR MEDIUMS NOT INJURIOUS TO STEEL OR SILVER SOLDER

CIRCUIT

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)



Provides any of following operations:

1. *Single Pole—Cut-in high (close on rise)*
2. *Single Pole—Cut-in low (open on rise)*
3. *Single Pole—Double Throw*

OPERATING RANGE

Adjustable Operating Range	Differential Fixed (Factory Set)	Maximum Surge Limits
1 to 20 psig	0.5 psig.	30 psig.

CONSTRUCTION

ADJUSTMENT: External
PRESSURE ELEMENT: Fairprene diaphragm
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

WRITE FOR BULLETIN 02

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

Bookshelf

Who's Who in Engineering, 8th Edition. *Produced under standards of qualification established by Advisory Committee of Engineers Joint Council. Lewis Historical Publishing Company, Inc, 265 W 14th St, New York 11, N. Y.*

This comprehensive biographical volume of the nation's outstanding engineers also includes a directory of engineering and engineering-connected groups. About 18,000 engineers are listed in the volume.

In addition to alphabetical indexing, the book has a convenient geographical index.

Engineering Societies Directory, 1959. *$3.50. Engineers Joint Council, 29 W 39th St, New York 18, N. Y.*

This first revision of the Directory since 1956 provides basic information on international, regional, state and local engineering groups. Address, membership, secretary, name and organizational publications are listed.

Six major sections cover the various groups, registration boards, Canadian engineering societies. Additional information is given on society abbreviations and the structure of the Engineers Joint Council. A canon of "Ethics for engineers" is included.

The Vertical Pump. *By Johnson. 392 pp, 7x10, hard cover.*

This book, published first in 1954 by Johnson Pump Co, is now available at no cost to POWER readers. The book is a comprehensive digest of information on vertical-turbine, mixed-flow and propeller pumps.

Starting with the development of ground-water resources, the book moves on to discuss construction and performance characteristics of the vertical pump, selecting the pump for different fluids, practical applications. Final section contains useful engineering formulas and data.

To get your free copy of The Vertical Pump, *circle 200 on Reader Service card, p 97.*

Safe Operation of Overhead Valves

with a

Babbitt *Adjustable* **SPROCKET RIM** *with Chain Guide*

- Simplifies pipe lay-out
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost *only* cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO

2 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

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a PERSONAL Subscription to POWER means—

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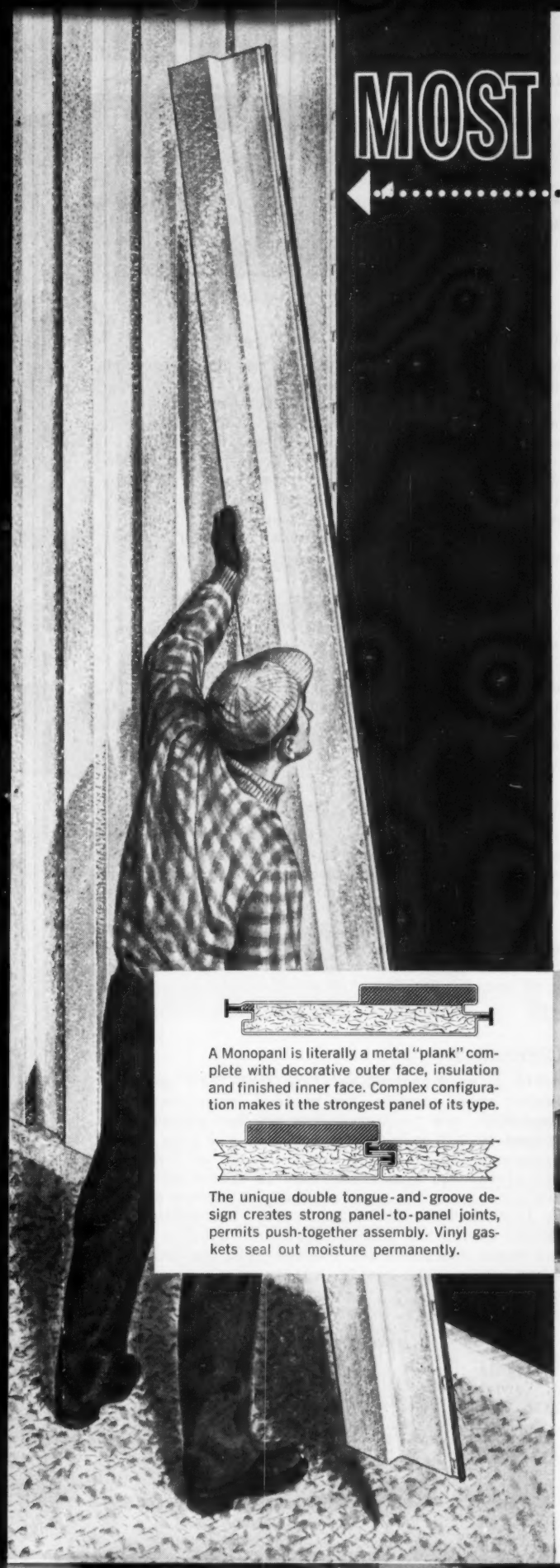

MOST ADVANCED

insulated curtain wall of its type

and it's brand new on Butler buildings

Here's a fellow that's literally making construction history. In one simple operation he's erecting a complete exterior wall, finished inside and out—fully insulated—and ready for use as installed.

This revolutionary advance in curtain wall construction is made possible with new Butler Monopanl. It is the first factory-fabricated, factory-insulated panel that is factory sized to fit a pre-engineered structural system . . . and it is exclusive on Butler buildings.

Today, even the largest Butler buildings can be enclosed in just days with handsome, slender—space-saving—curtain walls that permanently seal out weather and are equal in insulating ability to thick masonry.

Now, with new Monopanl, the Butler system of building is an even faster, better way to build . . . more than ever, the lowest-cost way to build well.

Call your nearby Butler Builder for full details. Ask him about Butler financing, too. He's listed in the Yellow Pages under "Buildings" or "Steel Buildings." Or write:

A Monopanl is literally a metal "plank" complete with decorative outer face, insulation and finished inner face. Complex configuration makes it the strongest panel of its type.

The unique double tongue-and-groove design creates strong panel-to-panel joints, permits push-together assembly. Vinyl gaskets seal out moisture permanently.

from a design by A. Francik and Associates, Architects

BUTLER

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(Advertisement)

HAGAN NEWSLETTER
Behind the Panel

ONE-MAN WATER PLANT HAS HAGAN AUTOMATIC CONTROLS

With a half-year of full rated production behind it, this 12,000,000 gallon per day water purification plant has been on full automatic since the day it was put into operation. Flows, levels and pressures are registered on a unique U-shaped control panel, and one operator is in full control of the plant operation. Hagan PowrLog pressure transmitters, Ring Balance meters and Power Positioners provide the bulk of the control equipment. Flows are totalized, and the total raw water flow matches exactly the totals registered by the four filters, where flow into the clear well is measured. Planned for eventual expansion to a total of 72,000,000 gallons per day, everything about the plant was designed with this in mind. The Hagan control panel is equipped with space and piping leads to accommodate future instrumentation. Low maintenance costs and positive control, well protected by safety interlocks, are some of the reasons Hagan was chosen for this installation. (Item I-1)

KYBERNETES DATA LOGGERS MONITOR TWO PETROCHEMICAL PLANTS

Two Kybernetes systems are helping to keep a petrochemical complex "on stream" by continuous scanning of the reactor catalysts and reactor effluent temperatures. If preset temperature limits are exceeded, an alarm is sounded and the abnormal point is printed on a special log sheet. In addition, periodic printout is made of all temperatures being scanned. In one plant, 350 points are logged and monitored, and in the other 200 are monitored but only a select 180 are logged. This permits operators to compare input values against pre-set limits, and provides data for overall evaluation of the process. Analysis of long term trends may lead to adjustment of values to obtain higher production. (Item I-2)

HAGAN pH MEASUREMENT AND CONTROL FOR INDUSTRIAL APPLICATIONS

For such pH control applications as cooling towers, quenching tanks, water clarifier operations or other areas where the control of pH is essential to the process, the Hagan system provides a high degree of accuracy. The system consists of a standard glass electrode and preamplifier, plus a Hagan Model H-0 PowrLog receiver for recording and control.

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COMBUSTION CONTROL SYSTEM--WITH A DIFFERENCE

Normally, a combustion control system derives its primary control settings from the high pressure end of the system. However, at this major steel company, two boilers, each producing 250,000 pounds of steam per hour at 950 psig and 900F, are regulated from the low pressure side. This came about because pressure was dropped to 280 psig at the turbine, and this pressure was required for other steam uses throughout the plant. By exact control of the low pressure steam, turbine efficiency is also maintained. The system has been in operation for a little over six years, and personnel are enthusiastic over the accuracy with which the system operates. Pressures are maintained despite the fact that demand varies widely. Extremely low maintenance costs are another reason why the Hagan system has gained approval. To quote their instrument engineers, "You have only to look at Hagan equipment and you can tell the control philosophy on which it is based, and how it works. This makes routine maintenance a very easy task." (Item I-4)

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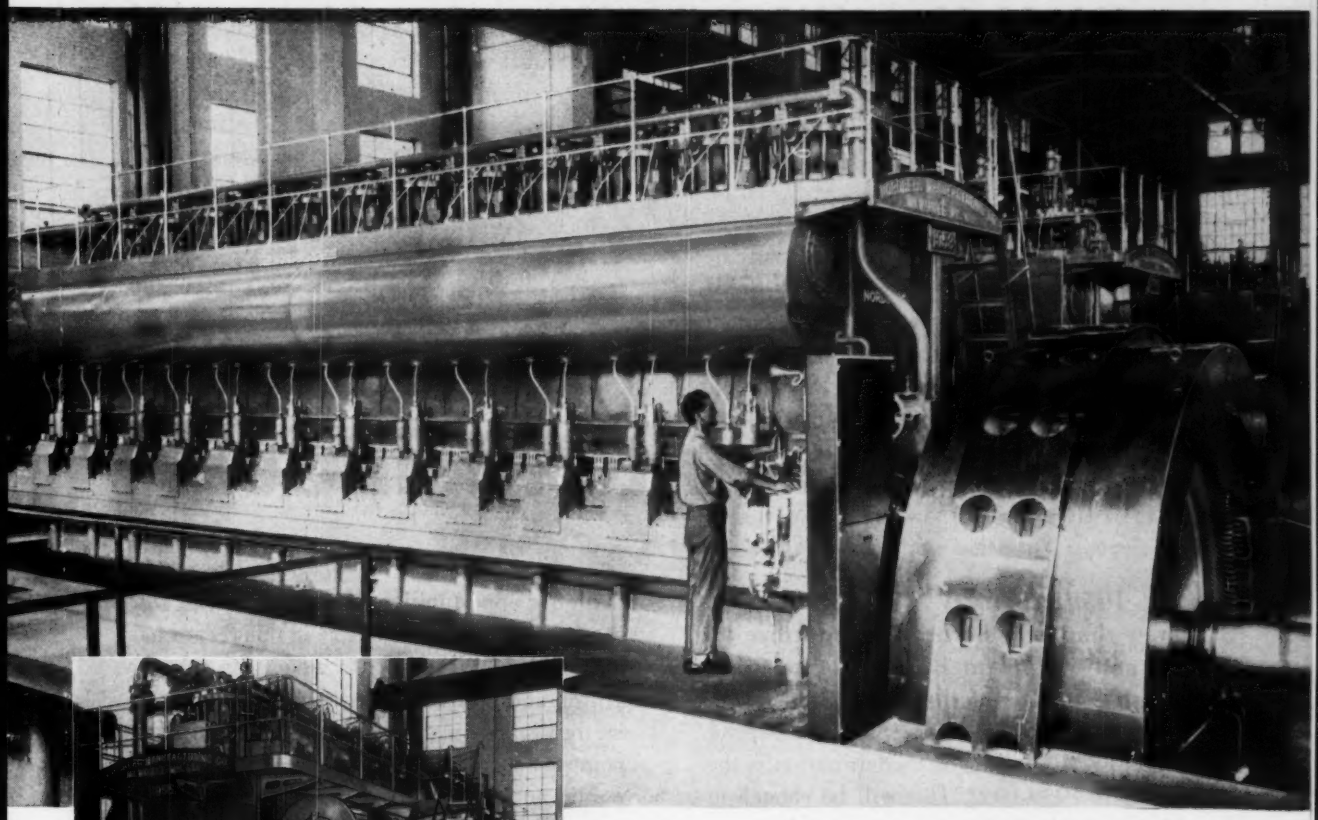
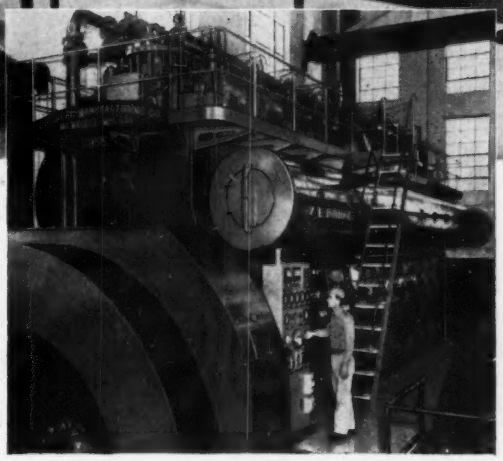
If you would like more information on any of the above items, check the appropriate box below.

☐ Item I-1 ☐ Item I-2 ☐ Item I-3 ☐ Item I-4

For more facts circle 317 on Reader Service card, p 97 circle 318 on Reader Service card, p 97 ➤

Why taxpayers vote YES ☒ for money-saving diesel power





In Ponca City, Oklahoma . . .

9 NORDBERG ENGINES help make a net profit of almost $1,000,000 a year

The world's largest dual fuel engine is helping the Ponca City, Oklahoma municipal power plant attain new records in production volume, operating economy, and net profits. This 8,500 horsepower Nordberg Duafuel® unit (shown at left), together with eight other Nordberg engines in this notable plant, produced a total of over 55 million kilowatt-hours in the fiscal year ended June 30, 1958, at a total production cost of just 5.67 mills per kwh. *Net profit for the year was over $920,000.00, and net plant profit for 10 years exceeded $7,000,000.00.*

Ponca City and its Light Department owe much to experienced Superintendent of Utilities Pat Schlesinger, who not only directs operations but engineered the big installation. This highly successful municipal plant is a joint achievement, with credit due to Mr. Schlesinger's able staff and to the many present and past city officials who cooperated in the development of this efficient and profitable municipal utility . . . an outstanding example for other municipalities to follow.

POWER PLANT PROGRESS

1924—First 1250 hp Nordberg Diesel installed at Ponca City.

1926—Second 1250 hp Nordberg Diesel installed at Ponca City.

1928—Two more 1250 hp Nordberg Diesels installed.

1937—2250 hp Nordberg Diesel started (converted to dual fuel in 1947).

1947—2400 hp Nordberg Duafuel engine installed.

1949—3600 hp Nordberg Duafuel unit added, one 1250 hp unit retired.

1952—4275 hp Nordberg Duafuel engine went into service.

1953—5135 hp Nordberg Duafuel installed.

1955—Ponca City's latest addition—10-cylinder, 29" bore x 40" stroke Nordberg Duafuel engine, rated 8500 horsepower.

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Plan '59

To modernize now for growth and profits

Goes Into High Gear

In 1959, industry will spend more money than ever before to modernize its plant and equipment. But it is not spending enough to do the job that needs to be done.

Manufacturing companies* now plan to spend a total of $24.5 billion on modernization in the four years 1959-1962. This will be enough to replace roughly 70% of the obsolete facilities that were on hand at the beginning of 1959. But it will still leave us far short of our goal. It would take several years, at a higher rate of investment than is now planned, to wipe out obsolescence and give the U. S. a truly modern industrial plant.

These facts stand out from the 12th annual Survey of Business' Plans for New Plants and Equipment just completed by the McGraw-Hill Department of Economics. This new survey shows that industry has made a remarkable start on the modernization job that a previous editorial in this series described as "the most expensive task to be performed in America in this new year of 1959." The full cost of modernization has been found by the McGraw-Hill Department of Economics to be $33.3 billion for manufacturing, and $95 billion for all business.

For the past several months, McGraw-Hill publications have been devoting special attention to new developments in plant and equipment that offer opportunities for modernization. Our special effort to help industry in this regard has been called "Plan '59": to modernize *now* for growth and profits. This editorial will summarize the progress made so far with "Plan '59" and point out some of the areas where business and public policies can do still more to accelerate the modernization drive.

A Good Start

Business investment in new plant and equipment has picked up sharply since the low point of the 1958 recession. Plans for 1959 now show a 7% increase over 1958 for total capital investment. And the increase in expenditures for modernization is much sharper. Moreover, companies already have substantial plans for the years after 1959. New orders for industrial machinery, which are a good index of modernization plans, also are running well ahead of last year.

For the four-year period 1959-1962, manufacturing companies expect, on the average, to devote 65% of their plant and equipment outlays to modernization. This is the highest proportion reported in a McGraw-Hill survey since 1950. In dollar terms, manufacturing companies plan to spend $24.5 billion on modernization during the next four years.

This is an impressive figure, but it does not look so large when compared with the total need

*Excluding petroleum refining, which is reported as part of the oil industry in the data discussed in this editorial.

for modernization in manufacturing industries. As noted above, a previous McGraw-Hill study (conducted in August 1958) found that it would cost almost $35 billion to replace all the facilities that manufacturing companies then considered obsolete. Thus, present plans for modernization are enough to wipe out only 70% of the backlog of obsolete facilities by 1962—and this makes no allowance for the additional facilities that will be made obsolete by new machines and new processes introduced during the next four years. When these new developments are considered, present plans for spending may represent only half the job that will actually need to be done.

How To Accelerate

What can be done to accelerate the drive to modernize our industrial plant and equipment? Two of the greatest aids would be:

(1) Improve present provisions under the tax law for depreciation, to help industry retain more of the money it needs to carry out this massive job of modernization;

(2) Contain inflation, to preserve the purchasing power of the money industry sets aside to replace obsolete facilities.

At first glance, the supply of funds from depreciation allowances appears to be more than adequate. For manufacturing as a whole, depreciation allowances—the primary source of cash for modernization—will total $8.3 billion in 1959, compared with present modernization plans of $6.4 billion. Thus some extra funds will be available to support a further step-up in modernization in 1960.

Unfortunately, however, these depreciation funds are not evenly distributed from industry to industry, or from company to company. For example, in several of the metalworking industries, the prospective flow of cash from depreciation during the next four years is much less adequate than for manufacturing as a whole. These are industries with relatively large modernization backlogs, and they also are industries made up mostly of small or medium-size companies that have difficulty tapping the public money market.

As a result of these industry and company differences, there are many individual cases where shortages of funds limit the amounts of modernization now planned. In the McGraw-Hill survey, nearly half of all companies participating said that they would spend more on new plants and equipment if the depreciation allowances permitted by the tax law were increased substantially over the next few years. Most of these were relatively small companies. Their answers suggest that revision of the tax rules on depreciation should receive the most careful consideration as a spur to faster modernization.

The problem is complicated also by the threat of further increases in the national price level, which would necessarily include prices of capital goods. If "creeping inflation" resumes its march during the next four years, depreciation allowances based on present costs will be much less adequate for future needs. This points up the importance of national economic policies to maintain price stability. Unless this can be maintained, industry's dollars will not go far enough to do the modernization job that is needed.

Plan '59 Carries On

Industry's drive to modernize is now well underway. It can make a key contribution to our national strength and prosperity in 1959 and the years ahead. But the biggest part of this job is before us. It is up to the policy makers—in both business and government—to see that the job is done.

This message was prepared by the McGraw-Hill Department of Economics as part of our company-wide effort to report on opportunities for modernization in industry. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

George Edwards

suggests a "capsule" study course

A recent month-long rest-up after some surgery gave me a real chance to catch up on long-overdue reading. I thoroughly enjoyed doing nothing but just loafing around and taking my good old time with some paperback whodunits and a stack of magazines dealing with what's going on in power-plant design, operation and maintenance circles.

In the latter, I ran across some air-conditioning statistics that left me a little surprised. I knew that lots of tonnage was going into plants across the country, but I wasn't aware of the *big* way that industry was going for this equipment. Nor did I realize that number of absorption systems installed appears to be growing at a husky rate.

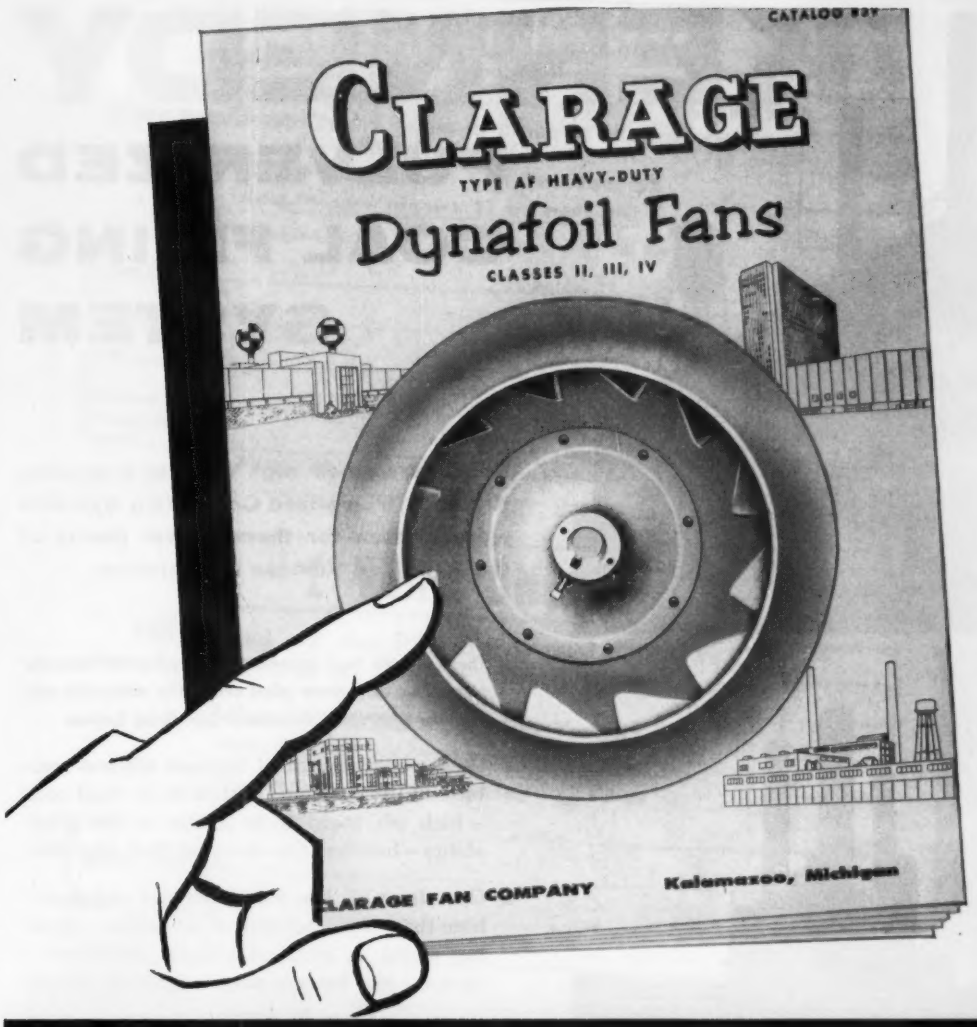
Published results of a study made by the Minneapolis-Honeywell people spell out one big reason for air conditioning's fantastic growth. Their findings: (1) As air conditioning spreads throughout industry a familiar pattern is coming to light. Equipment is installed to improve a product or a process. The predicted savings result. Then, alert management begins to note a marked increase in the efficiency of workers in air-conditioned areas. What might be termed a fringe benefit for employees turns out to be a major benefit for management. Efficiency increase due to better working climate is often so pronounced that profit upturn is more important than the returns on an improved product. (2) Honeywell comes up with a basic formula showing management how to determine air conditioning's profitability before installing it in *any* building. (3) Air conditioning is profitable if it increases worker efficiency no more than a mere 1.5%. This is really something to think about.

Something to think about, too, is what this may mean to the plant engineer who'll be responsible for this addition to his power services. Chances are he's a pretty smart cookie, but the best of us get a little rusty when we've been out of touch with certain equipment for years. He may be well versed in basic refrigeration theory, but air conditioning has come a long way in the last ten or fifteen years. Equipment types, controls, instrumentation, etc may be a far cry from the manually operated refrigeration systems he remembers. So he may have a little brushing up to do.

We all know that it's tough enough to find time for the reading we want to do to keep up with what's going on in our field, let alone taking on any added ***must*** reading. So where in the welter of reference material does he start to pick out exactly what he needs for a fast review?

I suggest that he huddle with his file of POWER special reports. Here he's got needed info in condensed chunks, fast moving, easy to read—straight dope not only on air-conditioning equipment and theory, but on closely related subjects. These, tied in with his equipment manufacturer's manuals, should help him take his new air-conditioning system right in stride.

Incidentally, my scouts in the McGraw-Hill building tell me that a new book is just about ready that'll make life a lot sunnier for guys on any rung of the power-plant operating ladder.



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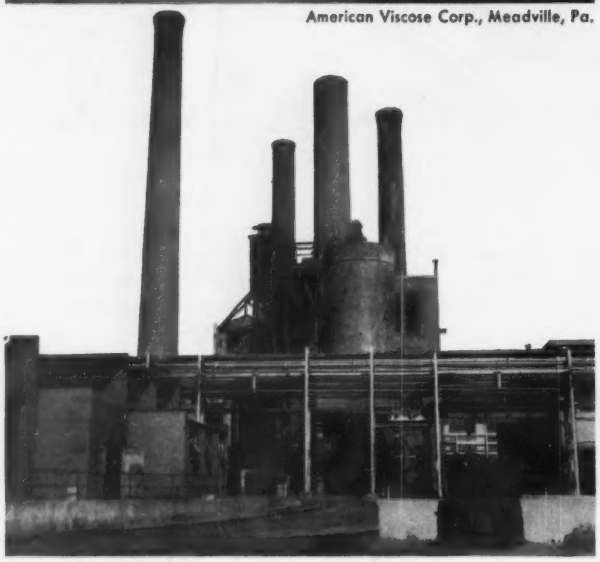

American Viscose Corp.
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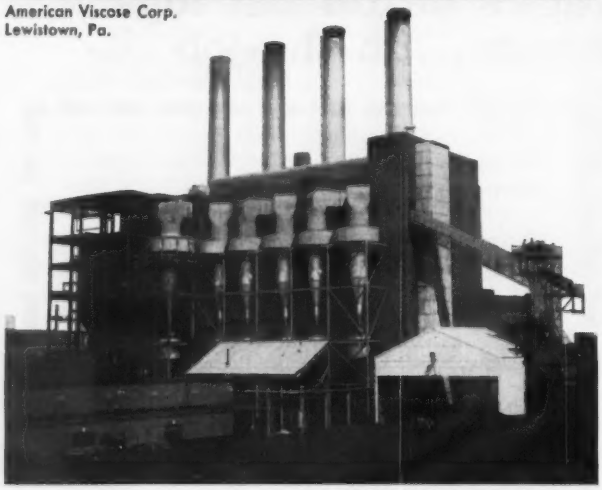

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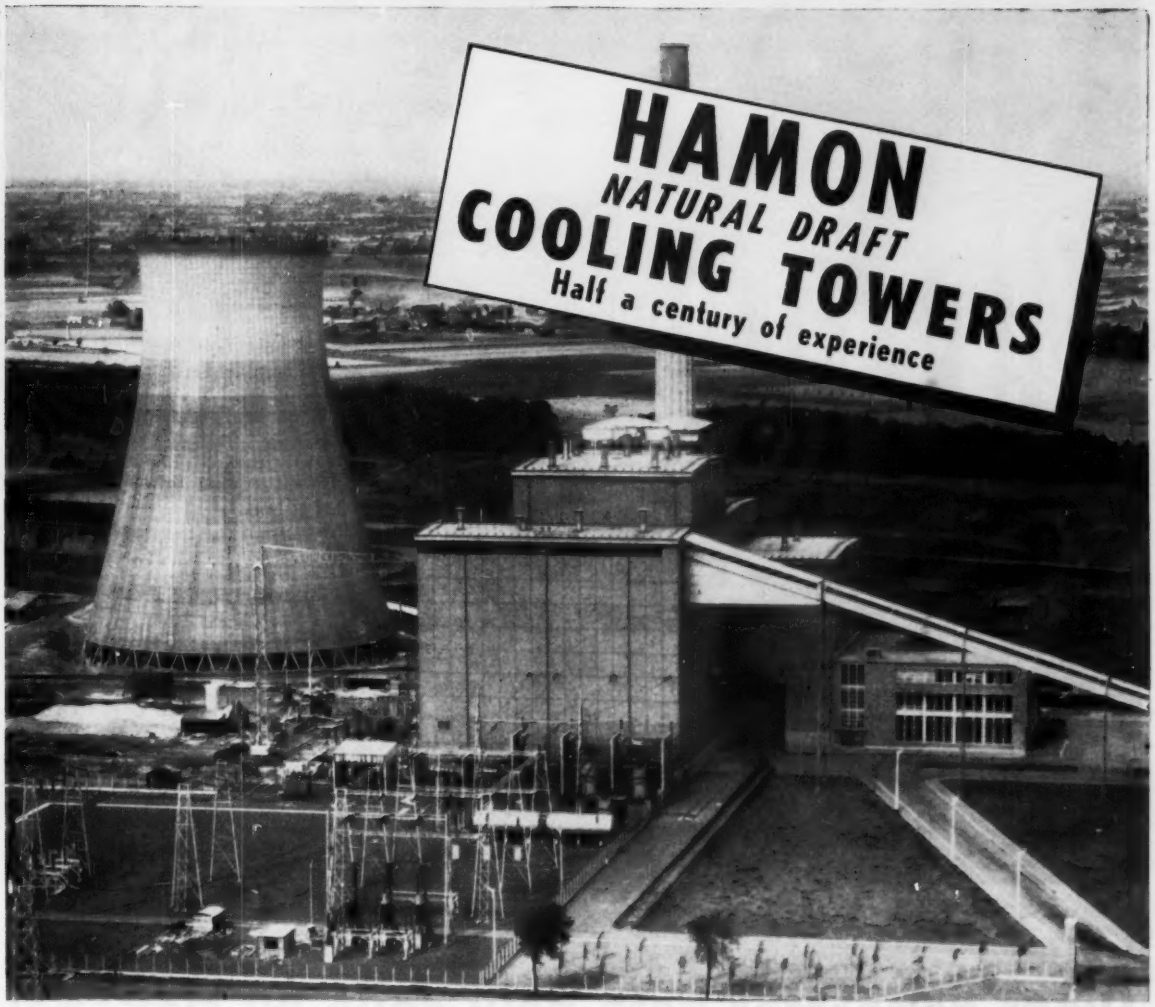

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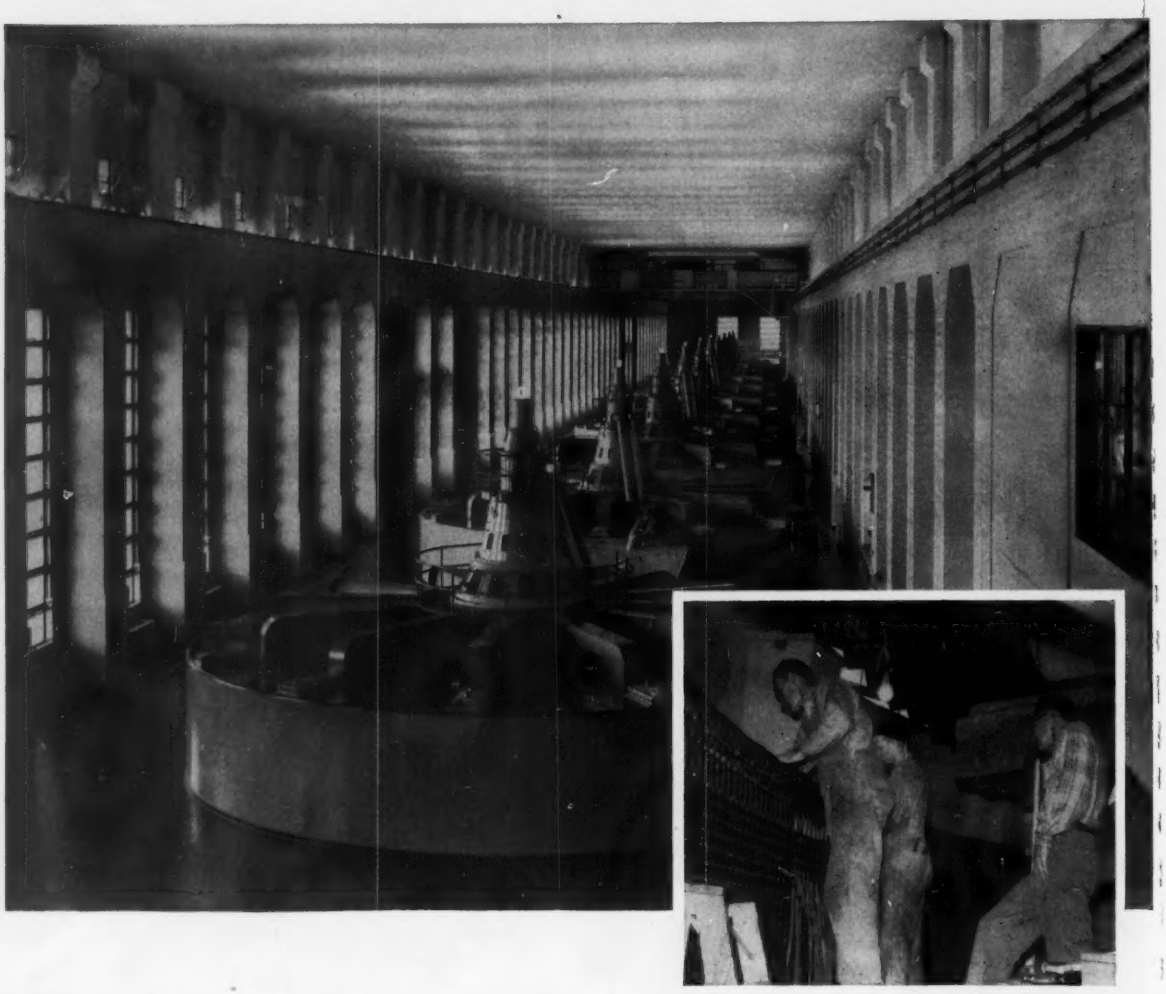

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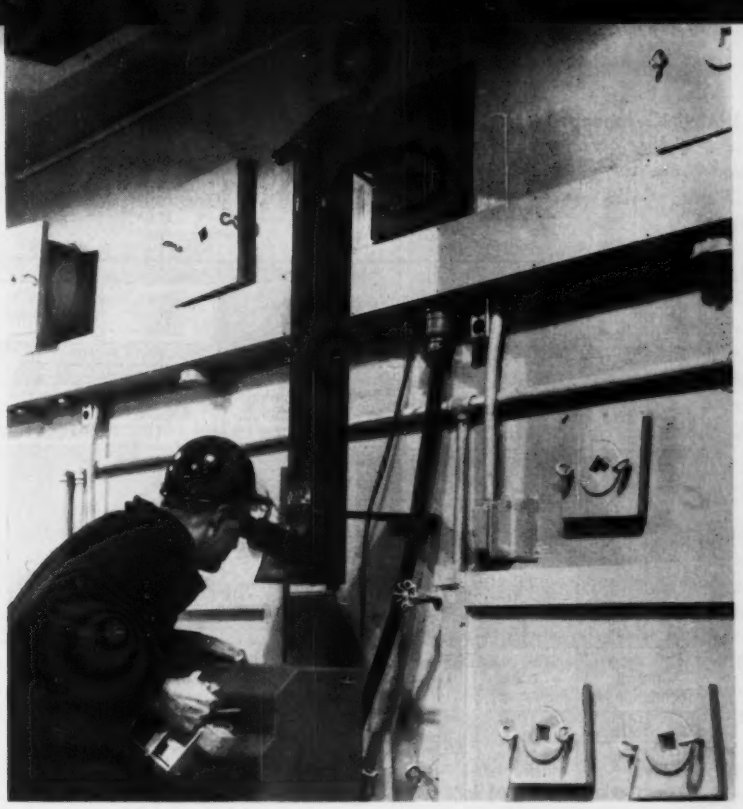
Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



RADIATION PROTECTION is most important difference between operation and maintenance of nuclear and conventional plants. Personnel must understand radiation hazards

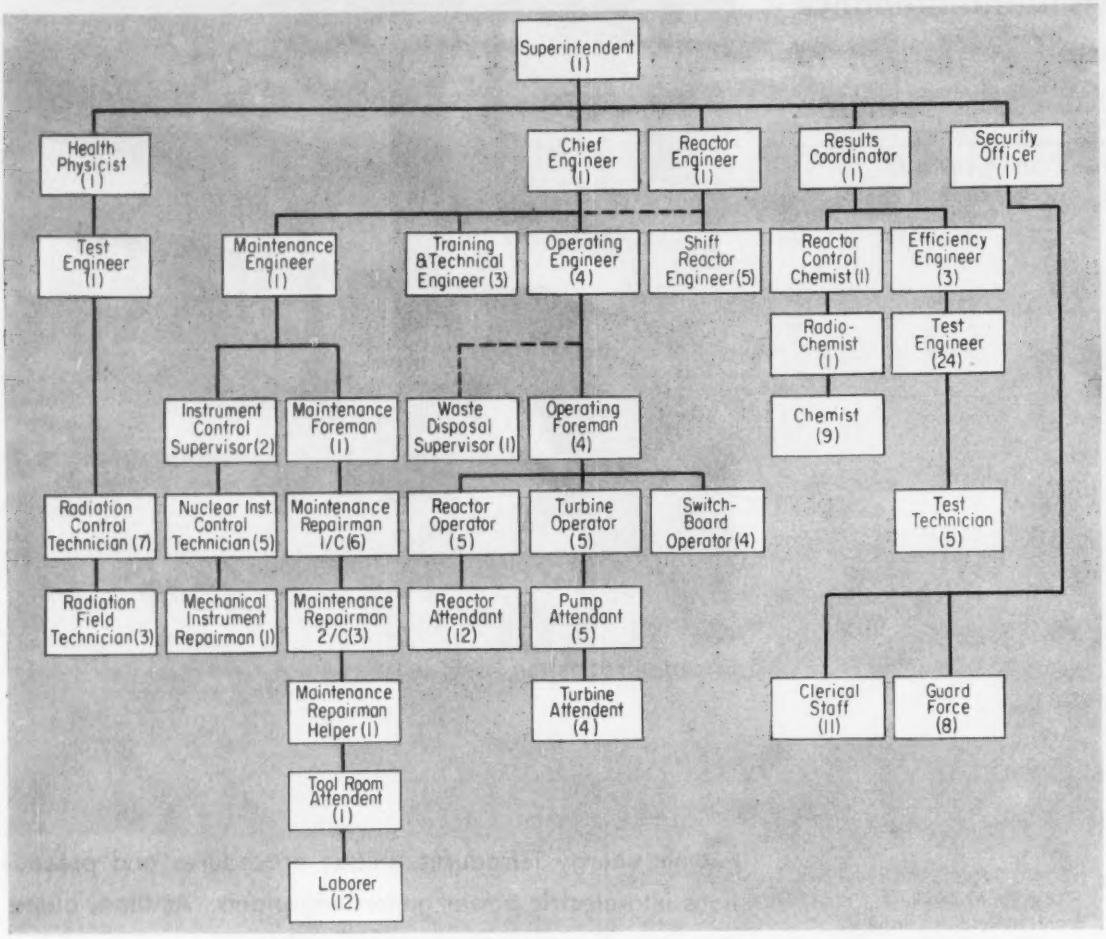
By HOWARD M VOLLMER and
RICHARD M TARRICE
Stanford Research Institute
Menlo Park, California

Atomic energy introduces unique procedures and precautions into electric power generating plants. As these plants go on the line there is growing need for . . .

A training program for nuclear-plant operators and maintenance men

Nuclear energy offers vast new opportunities in central stations and varied industrial applications. At the same time it creates new needs for knowledge and skills on the part of plant operating and maintenance personnel. (See POWER series, August, September, November 1956.)

Management, trade unions and public-school officials have recognized this need and seek training programs to qualify present and potential workers for jobs in which nuclear-energy technology is involved. The Atomic Energy Commission contracted with Stanford Research Institute, Menlo Park, California, for a report on *Development of training programs for operating and maintenance personnel in nuclear power generation systems.* Report deals with: (1) magnitude of training needs that now exist or may



Organization of typical nuclear power generation plant

SHIPPINGPORT nuclear station of the Duquesne Light Company was organized with above setup. Operation was divided into three areas of responsibility: reactor, turbine and electrical. Maintenance engineer heads the mechanical, electrical and instrument upkeep

be expected as nuclear-power generation systems develop (2) detailed plans for an introductory training course (3) general plans for consistently more-advanced courses.

Primary sources of data for the report were leading companies and installations where nuclear power plants are now in operation or are planned to be in the near future.

Nuclear plant organization

Organization of nuclear power plants involves five principle functions: (1) operations (2) maintenance (3) radiation protection (4) research and testing (5) miscellaneous service functions. Typically, operations break down into reactor, turbine and generator operation. Maintenance divides into mechanical, electrical, instrument and chemical process. These maintenance functions aren't always included in the maintenance section of a nuclear power plant. For example, at Shippingport (chart above) chemical analysis and maintenance of the coolant and heat-exchange system are under different direction. While the organization at Shippingport is typical, other plants will have variations in distribution of functions and responsibilities.

Radiation protection is the only unique function added to the operation of nuclear power plants. Special staffs are needed whose primary duties are the protection of plant personnel from the potential health hazard of overexposure to radiation. Men who perform these functions may be called *health physicists, radiation control technicians*, etc. They require a considerable amount of training, and this training is beyond the scope of the courses discussed in the report.

Since most nuclear power plants are at present in an experimental stage, their staffs often include research personnel to study the operation of the reactor and power plant system.

Plant operation

There are three basic operating units: (1) a nuclear reactor plus, in some cases, a heat exchanger (2) a steam turbine and (3) a generator. The nuclear reactor, in simplified terms, is a device in which heat is derived

from the controlled splitting of atoms. Heat thus generated is processed through a liquid medium to produce steam. The reactor in a nuclear power plant replaces the furnace and boiler used in a conventional power plant. After steam generation the process of power generation is similar to that in a conventional plant.

Nuclear power plants can be physically and organizationally separated into two major units. In some cases the nuclear plant simply supplies steam to an established electric power company. Where division into nuclear and power production sides exists there may be little, if any, need for special training of turbine or generator operators. However, where one company or agency operates both sides more training of turbine and generator operators in nuclear operations may be necessary.

Operating shift in a typical nuclear plant consists of a reactor operator, a turbine operator and a generator operator stationed at their respective control boards. They are assisted by one or more reactor and turbine-generator attendants who check and operate locally controlled equipment. Some plants have a centralized control room. Operators in each designation are trained in the other two, permitting immediate interchangeability.

Maintenance

The four types of maintenance functions ordinarily do not require an equal amount of attention in nuclear power plants. Relative amount of attention required is indicated by this estimate of man-hours per week in projected Army Package Power Reactor plants: mechanical, 100; instrumentation, 100; electrical, 50; water analysis and treatment, 40.

There are two basic maintenance policies. One holds that most of the maintenance will be done upon decontaminated materials in centralized shops, while only a small, roving crew will be needed for work on radioactive materials at a plant site. The other policy holds that it's most efficient to perform a larger part of maintenance at the plant site.

Latter point of view has been adopted by most companies; they've found that it's often less expensive. Furthermore, certain maintenance activities, such as analysis and treatment of liquid coolant and heat-exchange processes, involve direct contact with radioactive materials that cannot easily be decontaminated. So where a policy of emphasizing in-plant maintenance activities exists, maintenance men will require specialized training in handling and repair of radioactive materials.

There are safety limitations on the number of hours per week that men may be exposed to radioactivity. In emergencies the permissible short-time radioactivity exposure levels may have to be relaxed because of limitations in number of available maintenance personnel. Conversely, the number of trained personnel available should reflect personnel demands of emergencies to avoid plant shutdown. Organization plans for rotating maintenance men between radioactive zones and decontaminated shops conserve trained manpower.

Special training refers to any additional training programs required for operating and maintenance personnel because they work in a nuclear plant instead of a conventional one. Ordinarily a detailed understanding of intricate technical matters isn't required. What the workers need to care for expensive equipment and to protect themselves and fellow workers from potential hazards is an intelligent layman's appreciation of the nature of nuclear energy.

Job duties characteristic of a nuclear power plant operator's responsibilities are: (1) operation of reactor (2) reactor startup and shutdown operations (3) reactor fuel handling, involving the preparation, transfer, loading and unloading of nuclear fuel (4) *passing an AEC nuclear reactor operator's license examination.*

Training programs

In addition to the training programs of present and proposed nuclear installations, outside institutions are recognizing the need for training. An example of this recognition is a course first offered in March of this year by the Los Angeles Trade-Technical Junior College and by the Pasadena City College to power-plant operators, technicians and maintenance men. Course included such topics as some principles of atomic structure and radiation, energy from matter, nuclear fuels, reactors and reactor controls, radiation protection, etc. Length was 32 hours. Several trade unions have also adopted this basic course.

Stanford Research Institute has prepared an *Instructor's guide* for limited distribution on an experimental basis. Background reading for the instructor, reading assignments for students, motion pictures, charts, etc are suggested. The program is suitable for in-plant and adult education courses. The above-mentioned course is derived from it. The *Guide* will be revised for more general use.

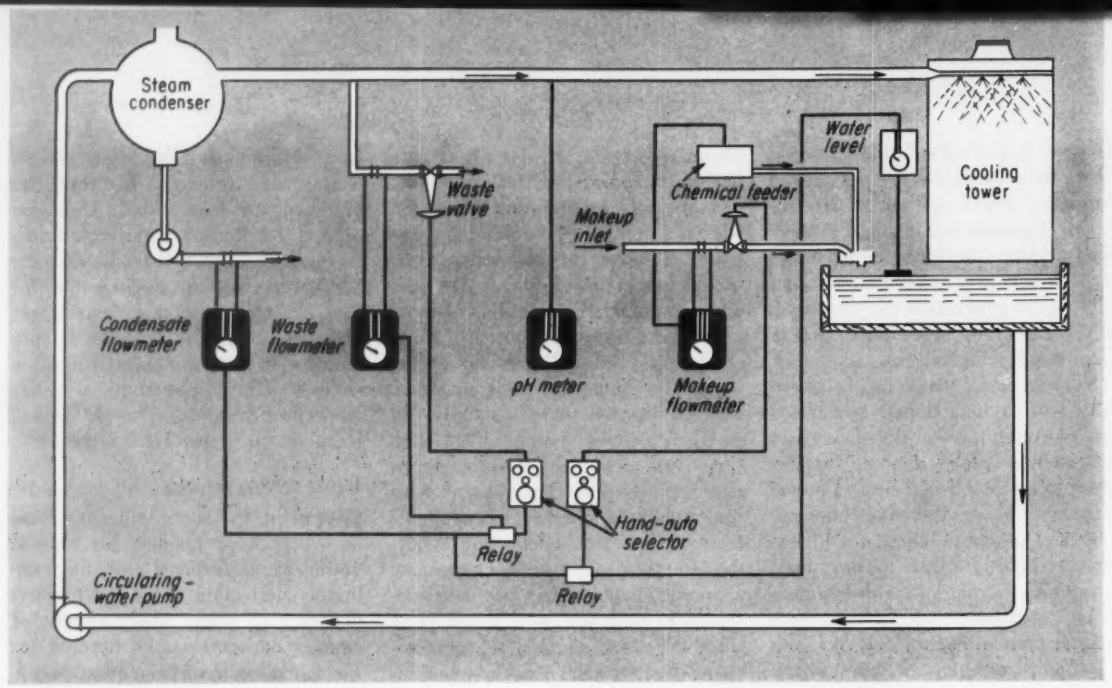
Course curricula

Content of special training programs in existence or planned for nuclear power plants indicate that the minimum curriculum necessary to meet the training needs would consist of courses or course units devoted to:

Elementary nuclear principles
Principles of radiation and radiation protection
Reactor theory
Nuclear power plant systems
Electrical systems in nuclear plants
Instrumentation in nuclear plants
Radiochemistry

Various operating and maintenance crafts may need different amounts of training in these subjects as well as additional special training in other subjects. Operators and all four maintenance branches will have direct interest in the *survey of nuclear energy* and the *principles of radiation and radiation protection* curricula. Opertors will also have direct interest in *reactor theory* and *nuclear power plant systems.* Mechanical maintenance men will include *reactor materials;* electricians, *electrical systems in nuclear plants;* instrument men, *instrumentation in nuclear plants;* chemical men, *radiochemistry.*

Even though the content of a specific training course is indicated by an analysis of training needs, as was the Stanford Research Institute project, you never know how effective such a course will be until the course is tried out in various types of training program. We can expect this practical experience with training of operating and maintenance personnel in nuclear plants to accumulate in the next few years. SRI, aware of this, is continuing its research in training needs of nuclear industries. It is planned this will lead to two new courses: one on radiation and radiation protection; other for workers in industries using radioisotopes.



AUTOMATIC COOLING-WATER SYSTEM uses condensate flowmeter to position makeup and blowdown control valves. Preset ratio of blowdown to makeup is maintained under all condenser heat loads. Flowmeter on makeup line adjusts the chemical feed

Cut water-treating chemical cost, reduce man-hours of operating labor, decrease condenser maintenance and conserve water by switching to . . .

Automatic control of cooling-tower water

By E W ROBINSON, Chief Engineer, Generation Plants Design
Southwestern Public Service Company

Problem of operating and maintaining condenser cooling-water systems is a familiar headache to many power-station operators. And difficulties are multiplying as more plants employ cooling towers to cope with a growing shortage of cooling water.

Need to conserve water and to reduce water-treating chemical costs, condenser maintenance and man-hours of operating labor is certainly well known. But it's a tough job without sufficient automatic controls.

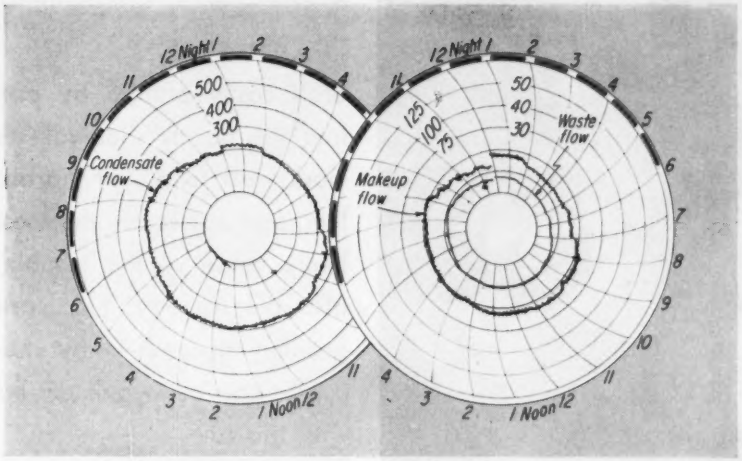
Consider a typical cooling-tower system with manual control. Assume that sulfuric acid is used to treat the makeup. Average amount of acid needed is pumped into the system on a manual on-off or continuous basis. A chemist checks pH and carbonate of treated water several times a day to spot under or over treatment. But his findings are too late to prevent any damage that has already been done. Scale and corrosion can still take place even though the average treatment is satisfactory.

Tests are also made for the total dissolved solids in the makeup and circulating cooling water. These two values give the number of times that the makeup solids concentrate. Number of concentrations directly influences scale-forming tendency of the water and must be controlled within a narrow range for best results.

Concentration of dissolved solids present in the system is regulated by amount of water bled to waste. Each water, depending on analysis after treatment, has a theoretical maximum number of concentrations that can be carried without forming scale. But it is almost impossible to maintain by manual operation of a blowdown valve. Usual practice calls for enough water waste to keep system concentration within safe limits.

Optimum results can be approached by making frequent water tests, followed by chemical feed and blowdown valve adjustments. But this is usually impractical because of added man-hours of operating labor. Most engineers prefer to wrestle with added condenser maintenance and increased water and chemical costs.

Many plants are located in dry regions where deep wells supply water for both industry and municipalities. Since rainfall is the only natural recharge to the underground water bearing strata, the conservation of water is extremely important to them.



RECORD CHARTS show how makeup and waste flows vary with the condensate flow rate. All readings are in terms of 1000 lb per hr

A typical power plant in the Southwest consumes as much as one to two billion gallons of water a year. Of this total 300 to 700 million gallons are lost as blowdown from the cooling system. Efficiency of an average manually operated cooling-water system is about 90%.

Stated another way, manual control increases blowdown at least 10% over the theoretical value. This waste amounts to 40 million gallons a year for a 100-mw plant. And there is a significant loss of treating chemicals. If sulfuric acid is used and the raw water contains 200 ppm of reacting chemicals, acid waste from excess blowdown equals 68,000 lb a year.

Now let's consider an automatic cooling-water system designed to (1) control makeup water treatment to minimize scale and corrosion (2) hold concentration of dissolved solids within narrow limits and (3) maintain correct cooling-tower basin level under all load conditions.

Our experience is with an automatic system developed for five plants. These plants contain a total of seven steam-generating units, ranging in size from 20 to 100 mw. An eighth generating unit, rated 100 mw, is currently in the design stages.

Control is based on quantity of water evaporated in the cooling tower and condenser heat load. Cooling water absorbs about 950 Btu to condense a pound of steam, and the cooling tower evaporates about one pound of water to release this heat to atmosphere. So ratio between condenser hotwell flow and water evaporated in the cooling tower is pound for pound when hotwell flow is directly proportional to condenser heat load.

Flowmeter in condensate pump discharge line is the primary control element. If hotwell receives other flows, such as boiler makeup, meter is compensated to indicate correct amount of condensed steam.

Adding one pound of makeup to the cooling-tower basin for each pound of condensed steam results in a constant water level. But evaporation rapidly increases concentration of dissolved minerals and the cooling water soon becomes too soupy to use. Remedy is to bleed water from the basin and replace it with makeup. Ratio of blowdown to evaporation losses is calculated from the raw-water analysis. Assume that total dissolved solids equals 200 ppm. Also assume that with proper treatment 600 ppm dissolved solids can be tolerated without scale formation. So number of concentrations here is three. Cooling system is then bled in ratio of one-third pound concentrated circulating water to each pound of treated makeup. Total makeup added at any given instant equals sum of evaporation losses plus blowdown and in this case is about 1 1/3 times the condensate flow.

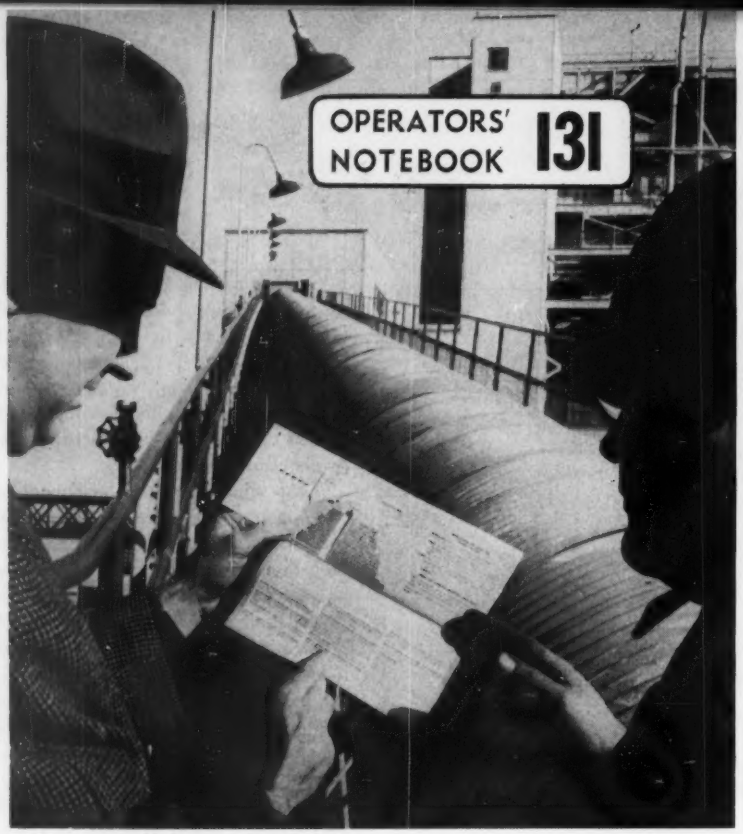
Flow diagram gives basic control components. Condensate flowmeter furnishes an impulse to position blowdown and makeup valves. Waste and makeup valves are positioned so waste flow is a fixed percentage of makeup flow under all condenser heat loads. Makeup meter adjusts chemical feed in proportion to flow. The pH meter checks performance and is a helpful guide when the raw water varies in quality.

Water-level instrument acts as an over-riding control in event of a system upset. Normally basin-water level is held within close limits by makeup and blowdown controls. But when these controls are inoperative the level-controller restores basin level to control point.

Our first automatic control system went into operation in 1952 and has given topnotch performance. Success at the other six installations proves its practicability.

Analysis of water costs at four plants using automatic controls was compared with costs at five stations employing manual operation. Significant differences were found. Water costs at the automatically controlled plants ranged from 1.0 to 1.7 cents per thousand gallons less than average costs at plants with manual operation and control.

These savings represent an excellent return on a very nominal investment. Many plants are already equipped with some of the basic instruments. Water level and condensate flowmeters commonly found in power plants can often be adapted for automatic cooling-water control. Cost of instruments in our seven systems ranged from $1400 to $4800. Complexity of the system and particular plant needs greatly affect these figures. But advantages of complete automation can usually be reaped with only a small added investment.



HANDY SLIDE RULE spots trouble quickly to keep this large conveyor belt working

Stop costly outage by putting this handy slide rule to work. Just feed it the problem, and out comes the most likely cause of the trouble, also the remedy. No more groping around — any mechanic can be a belt expert with this rule

Lick conveyor belt problems this easy way

By STEVE ELONKA, Associate Editor

Developed and distributed by the U S Rubber Co, this conveyor-belt troubleshooter is like having an expert on your team. Just feed it the problem and out comes the probable cause and the most likely cure. Many conveyor belt headaches have more than one cause, but this rule gives you a number of likely causes and cures, all in logical sequence, listed as 1, 2, 3, etc. A quick check of each one gives you the right answer by a process of elimination.

How to use. Let's say you have trouble with excessive top-cover wear, including rips, gouges, ruptures and tears. Pull out the troubleshooter slide until your problem shows in the upper window. Then read the probable cures in the lower window. Here they are: (1) Excessive impact of materials on belt or fasteners. (2) Relative loading velocity too high or too low. (3) Improper loading, spillage. (4) Improper storage or handling. (5) Damage by abrasives, acid, chemicals, heat, mildew, oil. (6) Breaker strip missing or inadequate. Check them all and you'll come up with the right answer.

Here are some more cures for common conveyor belt headaches that this slide rule gives you:

Belt bowed. Avoid telescoping belt rolls or storing them in damp places. A new belt should straighten out when broken in. If it doesn't, then replace it.

Belt improperly spliced, wrong fasteners. Use correct fasteners. Retighten after running for a short while. If improperly spliced, remove splice and make stepped splice. Set up regular inspection schedule.

Material falling between belt and pulley. Use skirtboards properly. Remove the accumulation, then improve your maintenance program.

Relative loading velocity too high or too low. Adjust chutes or correct the belt speed. Consider the use of impact idlers.

Belt strained (or elongated excessively) on one side. Allow time for new belt to break in. If belt doesn't break in properly or isn't new, remove strained section and splice in a new piece.

Damage by acids, chemicals, oils or deterioration by abrasives, heat, mildew. Use a rubber belt designed for your specific condition. For abrasive materials that work into cuts and between plies, make spot repairs with either a cold patch or permanent repair patch. Seal metal fasteners or replace them with a vulcanized step splice. Enclose the belt line for protection against rain, snow or sun. Don't overlubricate idlers of any conveyor system.

BELT RUNOFF is from idlers out of square

SIDE SHRINKAGE is from untrue section

LONGITUDINAL grooving is from boards

Differential speed wrong on dual pulleys. Make needed adjustment, then make sure you maintain right speed.

Drive underbelted. Recalculate maximum belt tensions and select correct belt. If line is overextended, consider using two-flight system with transfer point. If belt carcass isn't rigid enough for the load, install a belt that is.

Improper loading. Feed should be in direction of belt travel, at same speed as belt and centered on belt. Control flow with feeders, chutes, skirtboards.

Not enough traction between belt and pulley. Increase wrap with snub pulleys. Lag drive pulley so it has more tension. In wet conditions, use grooved lagging. Install correct cleaning devices on belt. Install centrifugal switch for safety.

Radius of convex vertical-curve too small. Increase the radius by realigning the idlers vertically. This prevents excessive tension on the edges.

Idlers frozen. Free idlers and lubricate—but don't over lubricate. Improve your maintenance program because this condition can cause excessive belt wear.

Pulley lagging worn. Replace worn pulley lagging with one of better quality. Use grooved lagging for wet conditions. Repair loose and protruding bolts.

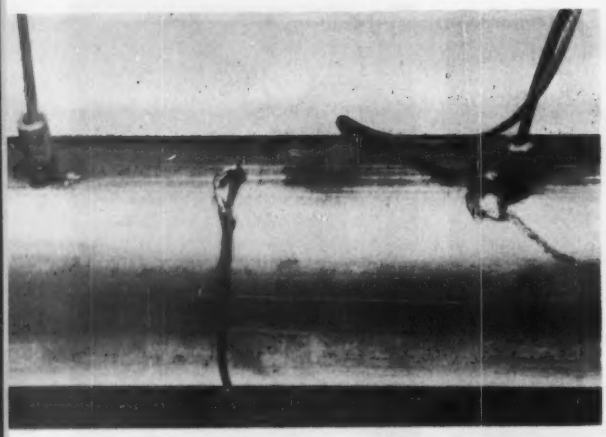
Counterweight too heavy. Recalculate weight required and adjust counterweight accordingly. Reduce take-up tension to point of slip, then tighten slightly.

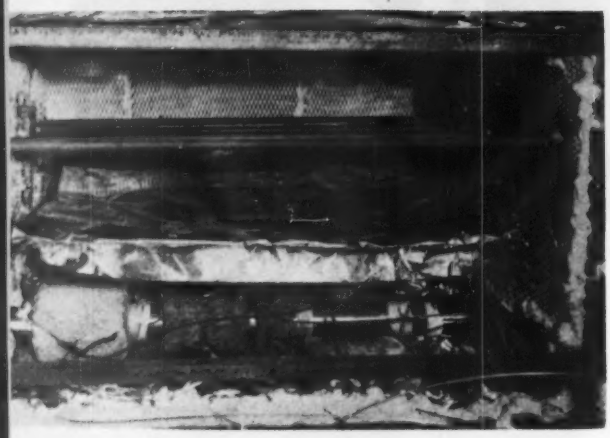
Edge worn or broken. This allows moisture to penetrate and belt to shrink on one side. Repair belt edge. Remove badly worn or out-of-square section of the belt and splice in a new piece.

These are just a few of the many problems solved.

EXCESSIVE IMPACT is from too much skirtboard clearance

BELT RUNOFF by one section is caused by improper splicing





By O D TERRELL
Knolls Atomic Power Laboratory*
Schenectady, N. Y.

Performance tests on the boiler of one nuclear sub spotlighted errors in temperature measurements. Lab tests proved scope of these errors and what caused them. Here are some resulting tips to help you . . .

Reduce errors

Thermocouples see extensive use as wide-range high-temperature sensors in engineering tests. For this work many special construction and calibration techniques are used to insure high precision of the element. But a significant type of measurement error results from ambient effects and from installation and insulation methods.

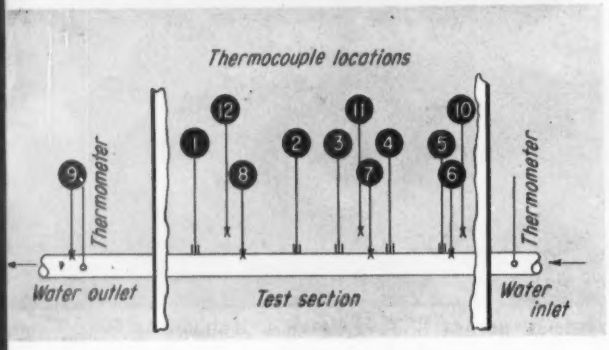
For example, boiler performance tests of a nuclear submarine showed some steam temperature measurements high enough to be questioned. Since the temperatures were measured inside a box-like structure which included primary coolant piping, we reasoned high ambient temperature might affect our readings.

Boiler tests required improved accuracy in steam temperature measurement. So we ran a series of laboratory tests to check sources of error, estimate their magnitude.

Laboratory test rig, left, included the pipe section with nine thermocouples. Three more thermocouples measured ambient air near the test section.

Thermocouples consisted of two types. The first duplicated the ones installed on the submarine. They had a 1/8-in.-diameter stainless-steel sheath and were held in place mechanically by a crimped collar welded to the test section. We varied amount of tack weld on the crimped collars and wrapped differing amounts of thermal insulation around thermocouple hot junctions.

Second type of thermocouple consisted of a simple beaded-wire unit, resistance welded to the pipe and wound



Test equipment duplicates boiler-temperature measuring problem

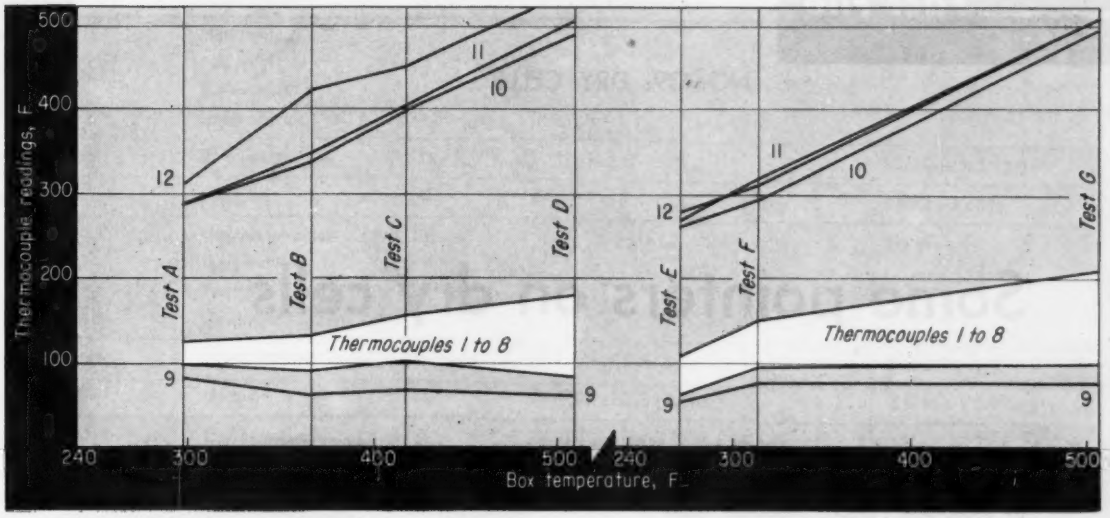
TEST THERMOCOUPLES were unsheathed type with beaded junction welded to pipe, and stainless-steel sheathed units held in place by collars welded to pipe

TEST BOX produces uniform ambient temperature by battery of electric heaters mounted above a radiation shield. Test pipe runs through box below this shield

THERMOCOUPLE LOCATION placed unsheathed and sheathed units in groups with varying degrees of insulation to check radiation and conduction heating

* Operated by the General Electric Company for the Atomic Energy Commission

Environment produced big measurement errors



THERMOCOUPLE READINGS show increasing difference between actual water temperature and recorded values as ambient level in box goes up. Thermocouples No. 1 to 8 produce band, with least error from units having thick thermal insulation, heavy collar weld

in your temperature measurements

once around test section. Insulation, where used, covered wound length as well as thermocouple junction.

Test results, right, show sheathed thermocouple errors were at best 8%, and at worst 20 to 30% of temperature difference between ambient and test section.

Specific factors resulting in larger errors were:

(1) Inadequate thermal insulation (less than 2 in.).
(2) Insufficient weld metal providing a heat path between test section and collar holding thermocouple.
(3) Mechanical coupling of thermocouple to collar on pipe instead of welding used with unsheathed units.

Least error appeared in readings taken with fully insulated, sheathed thermocouple. Other elements introduced increasing error as insulation thickness and collar weld decreased. Greatest error, shown above, occurred in measurements with uninsulated, sheathed units having a minimum weld between collar and pipe. Increased collar weld and no insulation produced less error than an element with light insulation and small collar weld.

Final conclusion was that sheathed thermocouples give minimum error if (1) hot junction is in intimate contact with test section (2) collar includes substantial weld bond and (3) entire area is covered with over two inches of thermal insulation. Under these conditions, errors should be far less than the 8% found in lab tests.

EDITOR'S NOTE: *This article presents one facet of the thermocouple accuracy problem. For more about the topic read* POWER's *coming article on temperature measurement.*

Test condition summary

Test no.	Water temp F	Barrier type	Box temp F
A	85	Aluminum foil	297
B	60	Aluminum foil	366
C	62	Aluminum foil	417
D	56	Aluminum foil	507
Note: Thermocouple insulation modified, barrier changed			
E	54	Stainless	269
Note: Thermocouple insulation modified			
F	90	Stainless	313
G	90	Stainless	507

Test results summary

	Temperature error, F		Water to ambient difference, F	Temperature error, %	
	Minimum	Maximum		Minimum	Maximum
A	16	45	212	7.5	21
D	39	99	451	8.6	22
F	26	58	215	12.0	
G	35	122	417	8.5	

Plant

Electrical Fact File

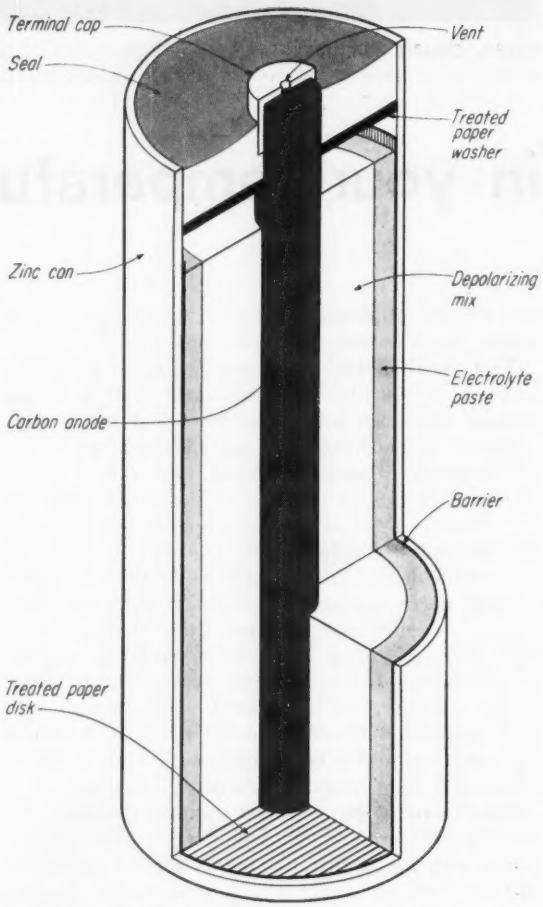
NO. 39: DRY CELLS

Some pointers on dry cells

By NORMAN PEACH, Associate Editor

Dry cells might have been more properly called "damp cells" since they contain some moisture. They're sealed to be "dry outside." Basic features are a metal anode, an electrolyte and a depolarizer cathode to prevent formation of hydrogen bubbles at the anode. Three types of dry cells are in general use for convenient, portable sources of direct current: (1) the familiar zinc-carbon cells (2) mercury cells (3) nickel-cadmium cells. The last are rechargeable; they're used in portable radios. Some people attempt to recharge zinc-carbon batteries; you can do it if you are careful, but it usually doesn't pay.

All dry cells are affected to an extent by temperature, nickel-cadmium cells the least. High temperature will ruin cells. Avoid storing batteries in damp places as this may cause corrosion of terminals.

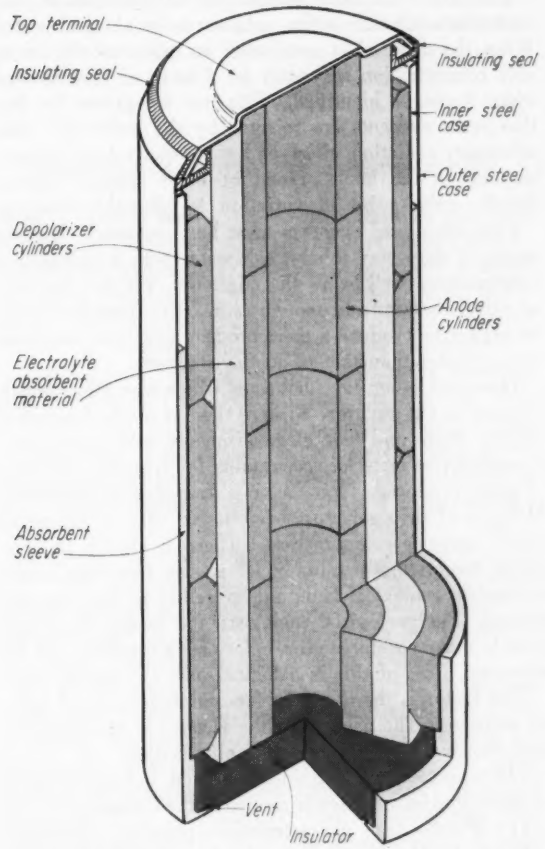


ZINC-CARBON or Leclanche cell uses a zinc can as anode, carbon rod as cathode. Fresh cells give 1.5 volts. Depolarizing mix is manganese dioxide, carbon black, ammonium chloride, zinc chloride and water. Paste of ammonium chloride, zinc chloride, and gel is electrolyte.

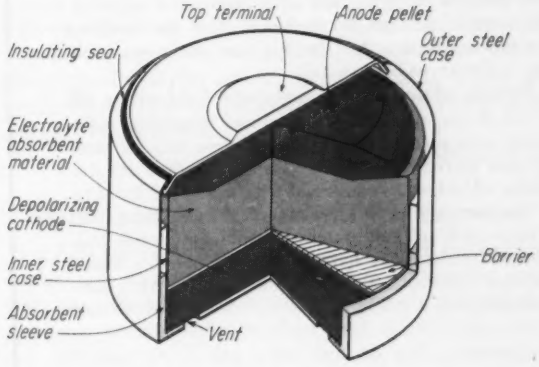
Useful data on some popular industrial cells and batteries

Designation	Application	Volts	Cell arrangement	Nominal dimensions, in.
Size D	Flashlights Industrial* Commercial* Instruments	1½	1 of D	1¼ dia x 2¼
Size C	Instruments	1½	1 of C	15/16 dia x 1 13/16
Size AA	Penlights	1½	1 of AA	17/32 dia x 1⅞
No. 6	General purpose* Ignition* Protective alarm* Telephone*	1½	1 of No. 6	2½ dia x 6
Standard lantern	Hand lanterns	6	4 of F in series	2⅜ x 2⅜ x 4
1½-v battery	Instruments	1½	4 of F in parallel	2 9/16 x 2 9/16 x 4¼
Emergency lantern	Emergency light	7½	4 parallel groups of 5 of F in series	7 3/16 x 3 31/32 x 5 13/16
Flasher lantern	Warning light	6	2 parallel groups of 4 of F in series	5⅜ x 2 13/16 x 4⅞

*Cells are manufactured for this type of service



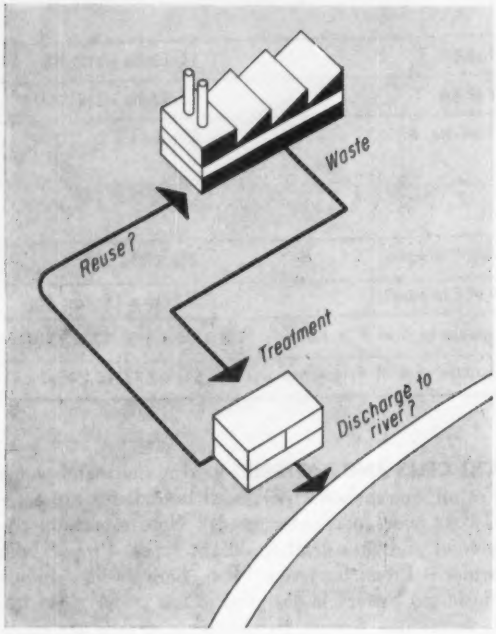
TYPICAL CELLS AND BATTERIES used in industrial plants (they're all zinc-carbon type). Cell ingredients are compounded to meet particular needs. Note especially the *commercial* and *industrial* flashlight types. Proper bulb for former is PR-2; for latter, PR-6 (both 2 cell). Industrial flashlight battery is designed to last under more frequent, steady use. Service requirements of cells are established by American Standards Association specifications.



MERCURY CELLS come in two forms, above and at right. They deliver more energy for a given size and weight than zinc-carbon cells, but they cost more. They're used mainly in portable electronic gear, such as walkie-talkies. Standard mercury cells develop 1.345 volts at terminals.

FLAT MERCURY cell, like the cylindrical cell, has anode of amalgamated zinc. Depolarizing cathode is mercuric oxide, to which may be added a little graphite and manganese dioxide. Concentrated solution of potassium hydroxide saturated with zincate makes up the electrolyte.

These plant problems could well be yours...



The problem

What disposal methods are best for fluid radioactive waste?

Our chemical-manufacturing plant is investigating a new process involving use of a radioactive material. My part of this project includes plans for handling the process wastes. And in this case the waste problem is almost too hot to handle.

Process effluent is a strongly acid fluid with a pH of 2.0. It contains both dissolved and suspended radioactive substances. To make the process pay we must be able to come up with a practical method for disposing of radioactive material with a 10-year half-life.

The plant site is on a river, several miles away from a large body of salt water. I would appreciate suggestions readers may have concerning possible waste-disposal schemes. We'll evaluate methods that look promising on a pilot-plant basis.—*SEL, May* POWER

The solutions

Three disposal methods may be suitable

Objective of waste disposal is to eliminate the probability of subjecting any elements of the surrounding population to a significant dosage of radiation. Generally speaking the available methods include: (1) concentration followed by fixation and disposal (2) dilution and then dispersion in water or the ground (3) concentration and permanent storage as a solid or liquid.

Although *SEL* gives half-life of the radioactive elements, it's also important to know intensity of radiation and the chemical composition. Since AEC regulations deal with distribution of radiation throughout the surrounding environment, type of radiation is extremely significant. Alpha and beta emitters, for instance, are dangerous chiefly when taken internally as a liquid or inhaled. Gamma emitters have a much greater radius of influence and call for considerable amounts of shielding.

Formulas have been worked out for permissible concentrations of radioactive substances in air and water. When the material is considered an unknown the allowable concentration may only be a tenth of that allowed when it can be identified. This just recognizes the fact that some elements are rejected by the body with only minimum radiation effect and that others tend to concentrate in the bones, blood or other specific organs. Result—quite a bit of variation in allowable dosages.

Even biological elements must be considered. For example, a clam may inhabit salt water with a radioactive concentration well below the minimum. Yet the clam can selectively concentrate enough radioactive material within its organs to produce a concentration over one thousand times greater than that of its environment.

There are other considerations which also affect waste disposal in a given area. First of these is *product accountability*. State and federal governments hold a producer of radioactive material accountable for type and quantity of waste produced. Next factor is *hazards accountability*. Methods of disposal must be followed that satisfy regulatory agency's safe practices. There is always an economic temptation to simply let wastes flow into some convenient geological fault, a deep well or perhaps porous ground. But geologists, ecologists and health physicists have to make careful studies before such practices can be approved. Cost of this is a logical part of disposal cost.

Last factor is the necessity for maintaining good public relations. The general public is already aroused and apprehensive over radioactive contamination.

SEL's problem can certainly be solved, but a good deal of additional information is needed in the following areas:

(1) *Waste*—(a) characteristics—physical, chemical, radioactivity (b) quantity—total volume, production rate, concentration of radioactivity.

(2) *Treatment facilities*—(a) decontamination required, dilution permitted (b) volume reduction needed.

...Here's how Power readers would tackle them

BOB MARKS, Associate Editor

(3) *Storage*—(a) location, size (b) materials of construction, shielding incorporated.

(4) *Disposal facilities*—(a) cribs (b) pits (c) wells (d) outfalls (e) sewer connections (f) other.

(5) *Environmental conditions* — (a) geological — general area information, depth of overburden, stratigraphy, soil characteristics (b) hydrology, ground and surface water—general description, elevation of water table, direction and rate of underground water movement, watershed characteristics, stream flow, turbulence, elevation, impoundments, stream biology, seasonal effects, etc.

(6) *Community considerations*—(a) downstream users of ground and surface water—distance, quantity, purpose (b) proximity of industrial and residential areas (c) agricultural and biological activities in vicinity.

Recommendations for waste disposal from the standpoint of economics and legality must take these factors into consideration. For material with a 10-year half-life, concentration, fixation in concrete and burial may be the answer. But kind and quantity of waste as well as availability of an isolated burial area will affect the solution. So it is evident that a great deal more information is needed to come up with the right recommendation.

P N GARAY, *San Jose, Calif.*

First concentrate the radioactivity

There is no stock answer to give *SEL*. In order to dispose of fluid radioactive waste, it's usually necessary to concentrate the radioactive material. And many different techniques are available to concentrate or remove radioactivity from fluids. These methods have had varying degrees of success. Most common ones include (1) coagulation and precipitation (2) slurries using powdered metal or clay (3) evaporation (4) filtration (5) electrodialysis (6) ion exchange or a combination of these.

SEL doesn't make it clear if radioactivity must be removed from the strongly acid fluid without changing its other characteristics. Perhaps the fluid is expendable. But whether it is or not it's still impossible to make a sound recommendation without having complete information. The disposal method best suited for his problem depends on type and amount of radioactivity, volume of radioactive waste, waste components that are not radioactive and overall economics of each treatment.

It's a good idea to make a complete study of the process producing or causing radioactivity. There may be a way to prevent this waste from becoming radioactive at all. Perhaps it can be kept in concentrated form for easier disposal. If this attack on the problem doesn't bear fruit the first task is to concentrate the radioactivity. This concentrate can then be buried in shielded casks or used as liquid or fill for making concrete blocks that may be taken out to sea for disposal.

W H ZAHN, *Philadelphia, Pa.*

Adhere to AEC regulations and advice

It can't be too strongly emphasized that radioactivity is unaffected by chemical or physical change of state. Only thing you can do is put the stuff away until the radioactivity ebbs to a safe level. This will take around fifty years using the rough rule of thumb that it takes five half-lives to reach a safe level.

Of course it is necessary to obtain a license from the Atomic Energy Commission for use or disposal of radioactive materials. Methods of waste disposal include: (1) dilution in air (2) dilution in water (3) burial and (4) disposal in deep water under rigidly controlled specifications. First two methods are practical only for very small quantities. In any case *SEL* must be guided by the rules and advice of the Atomic Energy Commission.

P D HOBSON, *Concord, Calif.*

Recovery and reuse may be worthwhile

SEL's problem has provoked some discussion in our group about the best method of disposal. There does not seem to be enough information given to establish an optimum solution. The reference to a 10-year half-life indicates the presence of Kr^{85} while the phrase "dissolved and suspended radioactive substances" may indicate the presence of a mixture of fission products accorded an average half-life of ten years. Disposal problems for these two apparent possibilities are quite different.

The disposal method depends largely on the total amount of radioactivity that must be disposed of. If the activity is quite small originally, dilution and dumping in the river mentioned may be satisfactory. But maximum permissible concentrations designated by the National Bureau of Standards must not be exceeded. This means that a person downstream from the evaluated point must be able to safely drink the river water from a radiological viewpoint. If considerable activity is involved, it may be necessary to filter, precipitate, concentrate or otherwise treat the material for handling and disposal at sea by normal commercial means now available. Actually, if the activity is considerable it may be worthwhile to recover and reuse the material rather than attempt to dispose of it.

H R KROEGER, *Raleigh, N. C.*

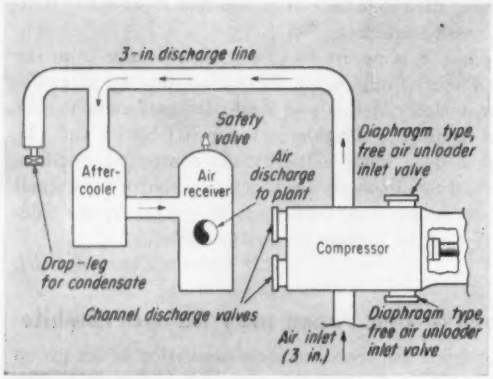
Contain-concentrate method is favored

Two basic philosophies exist in disposal of radioactive wastes: (1) dilute and disperse or (2) contain and concentrate. Selection depends on level of radioactivity, the particular radionuclides involved, type of radiation emitted, half-life, etc. I favor the contain and concentrate approach. It's easier to control and less total activity is discharged to the uncontrolled environment.

V W TENNEY, *San Mateo, Calif.*

Turn page for new problems ►

More **plant problems**



The problem

How can we avoid sticky discharge valves on our air compressor?

I'm steam-plant superintendent for a large paper company. Rough sketch, above, details our single-stage air-compressor system including aftercooler, air receiver and plant discharge. Compressor operates 24 hours a day, 5½ days a week. We use what is considered the best compressor oil available. Water temperature to the cooling jacket is maintained in the range of 100 to 110 F.

We are having a tough job keeping the top end-discharge valve free from carbon, sticking, etc. All valves are cleaned once a month, and each time this one valve is found in bad condition. How can we solve this problem?—*WDD, May* POWER

The solutions

Improved water circulation is needed

The fact that carbon formation and sticking occurs with only the top discharge valve points to excessive temperature at this valve. Poor water circulation in the cylinder head will bring this about.

Try increasing the cooling-water flow to eliminate any air pockets in the upper portion of the head. Improper gasketing can also restrict flow near the valve. It's also possible that the water passage is clogged with sludge or scale. Insufficient total flow of cooling water to jackets produces dead spots with faulty valve cooling.

Excessive temperature is also caused by recirculation of hot compressed air. First check for air leakage through the valve. Look for a bent or broken channel or spring, or a dirty or warped valve seat. Missing or damaged valve gaskets are another source of air leakage.

Cylinder cooling can be improved by replacing head gaskets with solid gaskets. External piping is then used to circulate water between heads and cylinder jackets. This gives more positive flow and improved heat transfer, particularly at cylinder head where most of heat must be removed by the cooling water.

J F CRAIG JR, *New York, N. Y.*

Remove scale in cooling water passages

Has *WDD* checked condition of the compressor cooling-water passages? These passages and probably the thermometer well, too, are covered with scale. So true temperature at the compressor valve is higher than indicated.

Scale will be a problem if cooling water contains over three grains hardness. An analysis of the cooling water and removal of the inspection plate on the compressor jacket will confirm or refute this suspicion.

When the compressor is not in operation, hook up a pump and tank to circulate a solution of inhibited hydrochloric acid through the system. A 25% solution heated to about 80 F and circulated for 16 hours should be sufficient. For best results make lab checks of acid concentration and add acid as needed to maintain solution strength in the range of 20 to 25%. When the treatment is completed flush the jacket thoroughly with water.

K N BANTHIN, *Broadview, Ill.*

Compressor needs top quality turbine oil

The proper oil to use in an air compressor is a high-quality turbine oil. This oil has the desirable properties of low carbon content and high oxidation stability. Both are necessary to prevent gum on the discharge valve. Viscosity is also important since oils that are too heavy contribute to higher operating temperatures and have a higher carbon content than a lighter oil of the same quality. Most manufacturers call for an oil in the 300-ssu range at 100 F. So *WDD* should make certain that he is actually using the best grade compressor oil available.

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

Other factors contributing to deposits on the discharge valve are overlubrication, poor air-cleaner maintenance and localized high temperatures.

Cylinder on a 24-in. compressor only requires about three drops of oil a minute. Amounts in excess of this don't improve lubrication; they actually create an excessive amount of carbon. This will eventually foul the discharge valve on WDD's compressor.

Poor air-cleaner maintenance or leaks in the air-cleaner system will allow dirt to enter the system. This can build up a very definite deposit on the discharge valve and cause rapid cylinder wear.

Local heating in the vicinity of the discharge valve may cause rapid oil oxidation on the valve. So the cooling passages should be checked carefully for obstructions.

Any major oil company can analyze deposits from the discharge valve if they are available in sufficient quantity. Presence of oxidized oil will show overheating or overlubrication. A large percentage of dirt will indicate poor air-cleaner performance.

H B MINICK JR, *Atlanta, Ga.*

Try fire-resistant synthetic lubricant

I strongly recommend the use of a fire-resistant synthetic lubricant. We have been using this type of oil on several 4-stage 3000-psig 100-hp reciprocating compressors for several years. And maintenance on these units has been greatly reduced. Practically no carbon or sludge forms on the valves. These synthetic oils have a fire point of about 665 to 690 F compared to 500 to 545 F for petroleum oils. This considerably higher fire point temperature greatly reduces the possibility of auto-ignition with resulting explosions.

We haven't had any appreciable increase in wear of compressor parts such as piston rings and cylinder walls since using synthetic lubricant. Although the cost is greater, we feel that increased safety from explosions and greatly reduced maintenance justify its use.

G BAUM, *Silver Spring, Md.*

Clean water jacket with sulfamic acid

The fact that one valve gives all the trouble indicates the presence of a hot spot somewhere in its vicinity. Sometimes the water jacket has rough spots in the casting that can't be smoothed out properly. Scale forms readily on these rough spots and builds up rapidly. So heat transfer at this point is greatly reduced. Since the valve is not cooled properly carbon forms. Even the best oil will form carbon at high enough temperatures.

A good cleaning with sulfamic acid removes this scale. The powder form is easier and safer to use than the liquid. We employ a small rubber impeller pump to circulate this solution through the water jacket. It's a portable outfit and can be used to clean aftercoolers or any other heat exchangers that become fouled. With periodic cleanings our compressors have worked well for six years.

A F JONES, *Miami, Fla.*

Run heat balance on compressor hookup

It's evident that combustion is taking place within the compressor. This is either caused by overheating, impurities in intake air or a poor grade of oil. Cooling water temperature is maintained at 110 F maximum. But there may not be enough water for effective cooling or the water jacket may be heavily scaled.

WDD should first give the water jacket a thorough descaling and use soft water for cooling. Then completely flush the oil system and fill with turbine oil. Next install temperature gages on cooling-water inlet and outlet and compressor-air outlet. These readings along with known cooling water flow and heat of air compression establish actual rate of heat removal. Then cooling water rate can be adjusted for satisfactory operation.

R L THEISS, *San Jose, Calif.*

Your August problems

What construction materials are best for our new smokestacks?

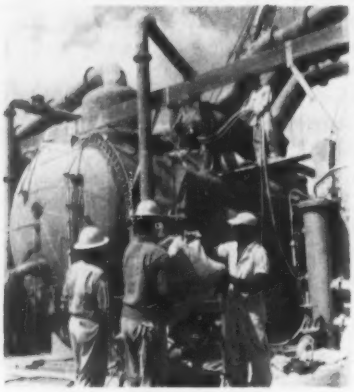
Our medium-sized manufacturing plant will soon have to replace two old smokestacks. They have given good service but are now too expensive to keep in repair. As yet we have not decided on construction materials for the new stacks. Materials under consideration include: (1) unlined plain steel (2) ceramic-lined steel and (3) glass-lined steel. We are leaning toward the use of ceramic-lined steel, but would like to have the opinion of POWER readers who may have recently wrestled with this same problem. What are the relative advantages and disadvantages of each material? How do they compare in first cost and amortized cost? What maintenance problems can be expected?—*SM*

How can we prevent wet insulation in our heating and cooling system?

Insulation on the water piping in our plant is giving us a lot of trouble. We have a year-round heating and cooling system with water at temperatures in the range of 40 to 175 F. One important reason for insulating this piping is to prevent condensation or sweating. Yet the insulation quickly gets wet and has actually fallen apart in several spots. We've tried to patch these sections without much success. It now looks as though all of the insulation will have to be replaced. Is there a satisfactory way of repairing the damaged sections? How can we keep the insulation dry and prevent its rapid deterioration? Any suggestions from POWER readers will be appreciated.—*TG*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve



Sprayed insulation halved costs at largest distilling plant

Problem was to cut construction time during a dry spell on Aruba so that Caribbean island's 55,000 thirsty inhabitants could get drinking water ahead of schedule from their new $11,000,000 sea-water distillation plant. This is the world's largest single plant for producing fresh water from the ocean. It's also the first conversion plant to produce marketable byproduct electricity.

The New York engineers, Singmaster & Breyer, who designed and built the plant started producing fresh water before applying insulation to the 215 F surfaces. There are 35 evaporators, each 11 ft dia, 30 ft long. Deaerators and main steam piping all needed insulation.

Applying block insulation to the cold evaporators before startup would have taken several months because of the size of the job, the many pieces of irregular equipment and the shortage of trained labor. So Singmaster & Breyer developed and applied what is believed to be a unique method of blowing granulated insulation onto hot surfaces. This method promised large savings. Granular material is cheaper than block, and untrained workmen can quickly be taught to apply it.

A total of 80,000 lb of lightweight expanded vermiculite insulation was forced through a standard "Gunite" cement gun nozzle by 100 psig compressed air. Water was introduced at the nozzle tip as mix hit the hot metal surfaces with high velocity.

There was no rebound, no steaming and adhesion was so good that the vermiculite can only be removed with chipping hammers. After placing the insulation to an average thickness of 2-in., workmen troweled the surface smooth and weathercoated it with a heavy premixed black asphalt.

Use of vermiculite and the spraying technique not only solved a pressing time problem, but also saved 50% in costs compared to the low-conductivity block insulation. But chances are that such a high saving could not be made in high labor cost areas such as we have here in the United States.

Water-washing fireside reduces temperature 40 F

Our oil refinery has three boilers, each rated 150,000 lb per hr, 600 psig, 750 F. Fuel is bunker C, refinery gas and natural gas. Makeup is 85%.

Last spring these boilers were acid cleaned internally. After they were returned to service the outlet steam temperatures averaged 720 F. Nine months later the outlet temperatures had gradually risen to 770 or 780 F, especially when burning butane. Efficient operation of the refinery depended upon the ability of the power station to burn butane in large quantities over extended periods. Yet to do so we were exceeding the maximum allowable turbogenerator inlet steam temperature of 750 F.

Our boilers were obviously dirty. After checking our water-treating procedures over the past nine months we concluded this wasn't the source of trouble. Our suspicions turned from internal tube fouling to external tube fouling. We knew the bunker C contained a small percentage of finely dispersed clay catalyst of the type used to crack gasoline stock. This catalyst always deposited on the firebox tubes in a fine powdery layer. In the past this layer had caused no trouble and was easily washed off during each shutdown. If we were correct in laying the blame here, how could we best clean the firebox with the boiler steaming at full load?

We first tried 125-psig steam with a steam lance. Results were disappointing. Next we tried water at 220 F and 150 psig. The lance was a 5-ft length of 1-in. pipe with a 30-degree bend and ⅛-in. nozzle on the end. With it we were able to throw a stream of water across the firebox and up to the roof. By working through two inspection doors, each less than 1-ft square, we were able to wash over 90% of the tube area. Our outlet steam temperature immediately dropped 40 F and has been holding at 730 F ever since. Incidentally, the boiler was kept on automatic control during the washing. Needless to say, on-the-line washing of our boiler fireboxes has been added to our bag of maintenance tricks.

A J SCHMIDT, *Mandan, N. D.*

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

Watch that maintenance bill—it can eat up profits

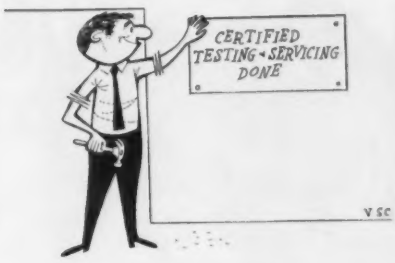
Did you know that in the average plant maintenance and repair takes almost 4½ cents of every sales dollar . . . and more than two-thirds of the net profit?

In heavy industries, maintenance cost is 17 cents of every sales dollar. This means that if you pay $2000 for a new car, you can figure that about $340 of it has gone into upkeep of the automobile factory.

Shop sweepers used to be called maintenance men. Today maintenance men are often college-educated white-collar executives and engineers.

Automation is causing the revolution in maintenance costs. Plant engineers reported at the Plant Maintenance Conference in Cleveland that in highly automated plants, such as an oil refinery or chemical plant, 80% of a company's total costs may be for maintenance.

All this means that if two-thirds of the net profit of a plant is eaten up by maintenance, then the plant and utility engineer can go a long way in doing something about it by keeping up with modern trends in preventive maintenance. You just can't afford to be behind the times here.



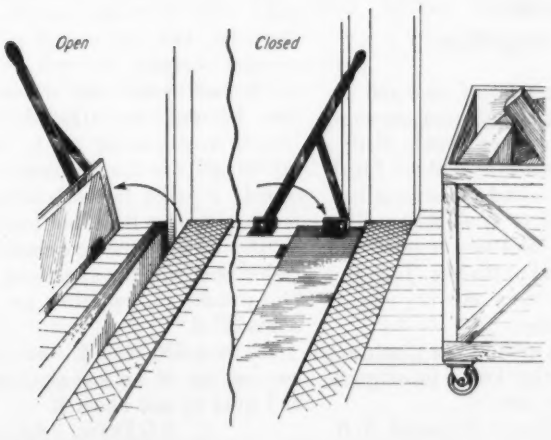
My favorite gripe

Why don't boiler insurance firms recommend that low-water cutouts and other critical safety devices be serviced by qualified service men, at regular intervals?

Here's my reasoning: George Edwards pointed out in POWER, March 1959, p 196, that six low-water cutoffs are no better, if they don't work, than one. It's not the fault of the manufacturer, for anything can get out of order if not properly serviced.

Since most states don't require a licensed operator on small boilers, (see *Plant Operator's Q&A*, Chapter 20, which will be published in August by McGraw-Hill Book Co), the low-water cutoff is the only safeguard. But the many boiler casualties published in the insurance magazines prove one thing—these safety devices don't even get the simple service they need, such as periodic draining so they aren't clogged with mud.

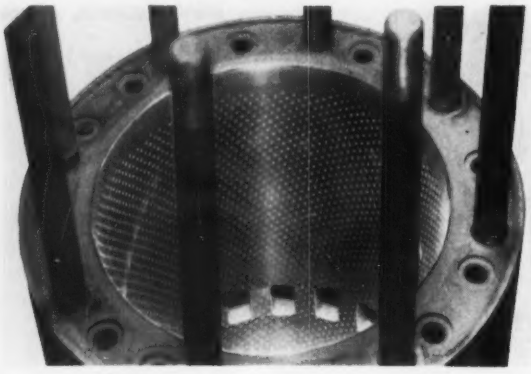
So, if every safety device were required to be serviced by a service organization of *certified* mechanics (high-pressure piping weldors are certified) then owners could rely on safety devices being the watchdogs for which they are intended. Why don't enterprising licensed operating engineers start such an organization in their community and see if they can sell enough industrial firms on periodic service contracts to make a good living? What do you readers think about this?—STEVE ELONKA, *Maintenance and Management Editor*



Gap closer solves our freight-elevator problem

Casters of our factory hand trucks are only 8-in. diameter, and kept getting stuck between the freight-elevator car floor and factory floor, especially when heavily loaded. We solved the problem by making a gap closer between the elevator car and its platforms on the different floors. Closer serves all floors and can be operated with one hand, so we eliminated our bottleneck in no time at all.

T STEVENSON, *Takoma Pk, Md.*



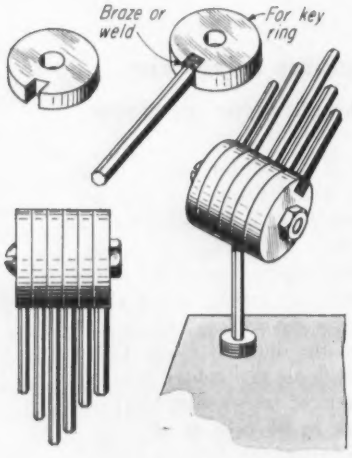
Now a textured-chromium plating for your diesel liners

New method of textured-chromium plating your diesel-engine cylinder liners reduces maintenance. Plating process is done by Chromium Corp of America, an affiliate of Metal & Thermit Corp. Worn liners are shipped to one of plater's plants, while you use spare plated liners to quickly return your engine to service. Plated liners often outlast unplated fourfold.

Chromium plating builds resistance to abrasive wear and chemical corrosion, reduces friction and is suited for combustion chambers. But, a smooth chromium finish doesn't retain lube oil. Now a textured pattern is used which creates minute reservoirs in the surface to retain the oil.

There are two kinds of textured patterns: (1) a random open grain surface and (2) the geometric pattern, photo. In first process, the liner is rebored and inner surface is blasted to produce a grained pattern in the iron. Chromium plating, which duplicates the blasted surface, is then honed to final dimensions. Finished surface has a random open grain texture. Second method applies a regular, geometric pattern to surface.

Wear in liner bore is always heaviest on the side opposite thrust. Most wear on liners sent in for salvage is about 0.015 in. on the diameter—but the overall range is from 0.010 to 0.060-in. After reboring, the plating is applied thick enough to restore the original dimension of the liner.



Keep your Allen wrenches together

You can save a lot of time and aggravation by making a compact set of small Allen wrenches, sketch. Drill a hole in the center of a short length of ¾-in. cold-rolled round steel bar. Cut off a disk to same thickness as the wrenches. Slot to suit each weld or braze the end of the hex. Then you can either put them on a key ring or bolt them together.

We use this trick in our plant; not only save time but keep a lot of quick tempers under control.

C H Willey, *Penacook, N. H.*

My biggest boner...

I worked as relief substation operator one summer. Station had two 66-kv lines, one 66/11-kv transformer bank, one 66-kv operating bus, a transfer bus, associated equipment for 11- and 2.3-kv distribution, plus a second 66/11-kv transformer bank.

One day I had to take a line out of service. On dispatcher's orders I opened the oil circuit breaker and disconnects on the line side, then closed the line ground disconnects. Foreman said the outage would be long enough for his men to change eight strings of insulators.

I walked around this switch, saw that the breaker bushings were very dirty. It was against regulations to be more than five feet off the ground without a checker, but I wanted to clean those filthy bushings!

I climbed the cabinet that housed the breaker operating mechanism. I checked the open line and closed ground disconnects, then started wiping the nearest lineside bushing.

Touching a metal cap on the bushing top I received a strong static kick. 'There must be a lot of capacity in this bushing to have that much of a kick,' I thought. Next bushing had a fine copper sliver adhering to the thread from where it had been partially torn. My bare hand touched the point; kick was enough to make me jerk sharply.

I looked at the open disconnects, then followed the stranded copper jumper from bushing top to disconnect hinge. *The bus disconnects were closed!* I yelled to the construction foreman to open them, but fast!

"Don't move," he screamed as he rushed over with the disconnect stick. "No wonder you operators get yourselves killed."

I'm the only person I know of who was on top of an energized switch and lived to talk about it.

E G Evans, *Adak, Aaska*

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1—Oil Circulating Pump Complete w/ motor
1—Oil Unloading Pump Complete w/motor
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2—20,000 gallon Oil Storage Tanks

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1—6000 kva, GE, 3/66000/2400/4160Y
1—2000 kva, Nia. Askarel, 3/13800/4160Y/2400
3—1000 kva, West. 1/13800/480
1—1000 kva, Standard, 3/44000/6600
1—1000 kva, Standard, 3/34400/2400/12000
1—1000 kva, Standard, 3/22900/2400/4160Y
1—1000 kva, Standard, 3/13800/2400/4160Y
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1138 CFM Disp Chge. Pneu. 20" x 12" x 14" air cyl. 12" x 14" steam—1945. Can be conv. to elec. 767 CFM Disp. I-R. 2—17" x 10½" x 12" air cyls. 2—10" x 12" steam 1946.

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37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	880
400	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
800	2300	G.E.	900
300	440	G.E. (hoist)	600
200	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2300/440	G.E.	TS	1200
200	2300/440	Whse.	Q	1200
150	440/220	Whse.	Q	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	SEDP	1200
300	2300/4000	Cont'l.	Spl-Prf.	720
300	2300/440	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2300	G.E.	KT	1800
200	2300	Cont.	TEFC	3600
200	440/220	G.E.	KT	720
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2300/440		KT	600
150	2300/440	G.E.	FT	1200
125	2300/440	G.E.	K	600
100(3)	4000/2300	L. Allis	OX	1200
100	2300	Cont'l.	TEFC	3600
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1— 600 Amp., Al. Chal., 15 KV, Outdoor
6— 800 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	800
50/60	230	Rel.	T	600/1800
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input., AC	Motor Type	Output V., DC
300	Whse.	4150/400	Syn.	250/125
250	Whse.	440	Syn.	250
125	G.E.	440/230	Sq. Ca.	125
135	G.E.	440	Sq. Ca.	250/125
100	G.E.	2300/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
70	El. Dyn.	440	Sq. Ca.	70
65	G. E. B	2300/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch. 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 13800—2300 V.
3—400 kva, G.E., 13800—240/480 V.
2—500 kva, G.E., 2400—240/480 V.
3—333 kva, American, 2400—240/120 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E., 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

3—35 kva, 900 R, 220 V, 3 ph. con. LeHoi, 6 cyl.
only partial listing

STEPHEN HALL & CO.
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BOILERS NEW UNASSEMBLED

# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE-2-4513

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCB	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	500	Penna.	(Askarel)	3	12470Y/7200-240
3	250	G.E.	H Pyranol	1	4800/2820Y/120/240
3	250	West.		1	2300/4600-230/460
3	200	G.E.	HSW2F	1	2400/4160-240/480
3	200	Al.-Ch.	CB	1	2400/4160-240/480
3	167	G.E.	HS	1	2400/4160-240/480
3	75	G.E.	KF	1	2400/4160-120/240
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
4	25	West.	Hypersil	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	50	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480—1200
1—Wisconsin Gas (Air) PB-99 7.5 KVA Master 1 or 3/120—2200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
1	75	G.E.	1160	MT-547	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	450	West.	1800	CW-4-30-9,	220 or 440
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M569Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	92	West.	425/1000	SK 118
1	50	G.E.	1750	173 FR
1	30	West.	690/1400	SK-4G1543

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis Chalmers, 2300/4160Y
1—275 HP, 1180 RPM G.E. Type KT 559BS 2200V
3—200 HP, 1780 RPM, G.E. Elec. KF, TEFC, 2300V
1—100 HP, 1775 RPM G.E. KTP-543 3Ø 60-440V.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Form BL 2200 V.
125 HP 600 RPM G.E. Type TS 2300 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HU 3600 RPM G.E. type TS Fr. 956Y 2200 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
325 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

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Unused— BOILERS —Assembled

60,000 LBS/HR—475psig—Comb. Engr. package water tube boilers with superheater and economizer, oil fired. Four (4) units available for immediate shipment.

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2—250 KVA, 1/60/2400-240/480 Moloney, OISC, type YC, W/taps.
1—230, 4—150 & 2—100 KVA, 1/60/4160-120/240 Whse. Inerteen w/taps.
1—300 KVA Wag. 1/60/2300-115/230
3—100 KVA 1/60/4160-240/480 Packard OISC
3—25 KVA, WHSE. 1/60/2400—240/480 OISC.
2—50, 6—37½ KVA, G.E. 1/60/2400-120/240 OISC.

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3/60/13,200 AC to 600V. DC

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2— 500KW Mod. 6RG-45-CH2

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Full Automatic AC & DC Controls

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TURBO GENERATORS

3000 KW GE CURTIS. CONDENSING. 365# ISP. 200° FS 3/60/2300 VOLTS. NEW 1930. FULL AUXILIARIES. BARGAIN.

15000 KW ALLIS CHALMERS. CONDENSING. 250 OR 425# ISP. 700°. 3/60/13200 VOLTS. 1800 RPM. WHEELER SURFACE CONDENSER. AUXILIARIES. NEW IN 1924. IN SERVICE.

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2—600 GPM Gould 6 stage 2310' head with 500 HP Westinghouse CST-583H 3600 RPM 440 volt squirrel cage motors and enclosed reduced voltage starters.

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72x18—78x20—84x20 HRT Boilers
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125—75—30—20—15 HP Exp. Proof Mtrs.
125—150—400 HP Slip Rg. Mtrs. Others
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Transformers: 333—300—150—75—37½ KVA
300 KW Generator Dir. Con. Unaflow Eng.
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TREMENDOUS SAVINGS ON ALL POWER EQUIPMENT!

PUMPS

10 MAIN FEED PUMPS

PUMP: Ingersoll-Rand — size 5" — three stage — capacity 500 GPM @ 750# discharge pressure. B.H.P 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq. inch — non-condensing — back pressure 20# — 5000 RPM — 330 B.H.P.

GEARED TURBINE-DRIVEN MAIN FEED BOOSTER PUMPS

PUMP: Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure 575# — back pressure 20# — 12.5 HP — 5500/1750 RPM — mfg by Terry Steam Turbine Co.

2 MAIN FEED BOOSTER PUMPS

Same as geared turbine driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard control. Across-the-line starter with pushbutton.

8 GEARED TURBINE-DRIVEN VERTICAL CONDENSATE PUMPS

PUMP: Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. *Capacity:* 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq. inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

2 AUX. FEED BOOSTER PUMPS

PUMP: Vertical — mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star motor, with control.

BRONZE RECIPROCATING STANDBY FEED PUMPS

11 x 8 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800/900# discharge pressure — 575# working pressure.

4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS

PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS

PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

3 MOTOR DRIVEN MAIN CONDENSATE PUMPS

Mfg. by Buffalo Pump Co. — vertical 2-stage — 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM. *Motor Data:* 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with pushbutton station — mfg by Ward Leonard.

8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS

Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

4 TURBINE-DRIVEN GEARED FUEL OIL BOOSTER PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq. inch discharge pressure.

6 FUEL OIL SERVICE PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 85 GPM — 350# discharge pressure — 560 RPM — 27.4 BHP. *TURBINE:* 1 stage — 578# non-condensing — exhaust pressure 15# — mfg. by Northern.

VALVES

THESE ARE JUST A FEW OF THE MANY VALVES OFFERED. ALL TYPES ARE AVAILABLE INCLUDING REDUCING—SENTINEL—RELIEF—MICROMETER — PRESSURE REGULATING — ANGLE, ETC! STEEL—600# SERVICE—SEND US YOUR REQUIREMENTS FOR QUOTATIONS

LESLIE 2" GOVERNOR VALVES

Type C.P. — class A — capacity 7640#/hr. — 575# steam pressure — 750# discharge pressure.

MOTOR OPERATED GATE VALVES

Low Pressure — comp. geared — 38" — mfg by Chapman Valve Co. *MOTOR DATA:* H.P. 18 ft. lbs. running torque — 45 ft. lbs. max. starting torque — 440 volts 900 RPM 3 phase 60 cycle. Type: Submersible Valve Brake — Motor: Star Electric Co.
Also available, same as listed, but 36", and 28" inch as listed, but with smaller motor.

MISCELLANEOUS

AIR COMPRESSORS AND BLOWERS

18 WIDE RANGE FORCED DRAFT TURBINE-DRIVEN BLOWERS

9 R.H. — 9 L.H. — mfg by B. F. Sturtevant — propeller fan type — capacity 29,500 CFM/5540 RPM/250 BHP — 8250# steam/hr. — and, 9,000 CFM/1985 RPM/9 BHP — 690# steam/hr. — 7 blades — static: max 35" water — normal 21.5" water. Driven by Sturtevant turbine type VC-7 — non-condensing — single stage — 250 HP — 575# steam pressure — 15# PSIG exhaust pressure.

2 LOW PRESSURE AIR COMPRESSORS

Mfg. by Gardner-Denver — vertical tpye — 101 CFM @ 100# discharge pressure — 2 stages — 5¾ x 4¼ bore — 5" stroke — 870 RPM — 25 BHP. *MOTOR:* 28.6 HP — 900 RPM (sync) — 440/3/60 — mfg by Diehl — with Cutler-Hammer control.

1000 KW TURBO-GENERATORS

(4) — Westinghouse—440/3/60 — 850° — 540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

LUBE OIL COOLERS

4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120°F — temp. water inlet — 85°F — outlet 90°F. Number of ⅝" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

MAIN CONDENSERS

Mfg. by Foster-Wheeler — 23,500 sq. ft. cooling surface — 40,500 GPM circulating water — total tubes 8,976, of cupro-nickel, as follows: (550) each ⅝" x 0.066 and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr. — vent condenser — single pass — heating surface 174 sq. ft. — all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

WILL SELL SEPARATELY FOR TESTING, WIND TUNNEL OR SIMILAR WORK. *(2) High pressure* — 24,400 HP — 12 impulse stages — 4909 RPM — working pressure 540# — 825°F. *(2) Low Pressure:* 28,600 HP — 3913 RPM — working pressure 49# steam — 424°F — 2-6 stages of impulse.

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Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 53rd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	440	900
600	Elliott (3)	Sq. Cage	2300	900
500	Whse.	Sq. Cage	2300/440	1200
500	Allis Ch.	Slipring	2300/440	600
500	GE.	Slipring	2300	900
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	2300/4000	400
350	Br. Boveri b.b.	Sq. Cage	4800/480	720
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	900
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	G.E.	Sq. Cage	2200/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E. T.EFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	600
250	G.E.	Synch.	2300/440	360
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. (2)	Sq. Cage	2200.440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. T.E.F.C.	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. (2)	Sq. Cage	2200/440	720
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Cr. Wh.	CCD	250	850
75	Gen. Elec.	CD-123	125/250	1200
75	Allis Ch. b.b.	EB-146L	125	1500
60	Ideal	D	125	1150
50	Whse.	SK-133	250	1750
40	Reliance b.b.	230-T	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-210	230	220/1000
150	G.E. b.b. dyn.	TLC-50	250	1750/3500
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
80	Whse. dyn. b.b.	SK-123L	250	1800/5000
75	Whse. (3)	SK-160	230	550/1150
60	G.E. TEFC b.b.	CD-185	230	1150
50	G.E. drip b.b.	CD-1445	230	300/1200
50	G.E.	RF-16	230	250/1000
30	Whse. b.b.	SK-133	230	400/1600
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.	220/440 AC	250 DC
75	G.E. b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
40	Ideal	220/440 AC	250 DC

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3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63456	1200
500	*G.E.	I-18-E	900
850	*G.E.	KT-850-A	1800
300	*G.E.	K6344	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-500-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
250	*G.E.	FT-549	3600
200	*G.E.	I-K-13B	1800
200	West.	CSP-581-S	1800
200	Brook	RS-27	1200
200	*West.	CS-930-A	900
200	G.E.	KT-564-S	720
200	*Al.-Ch.	AN-87-S	720
200	*West.	CS-1010	600
200	Al.-Ch.	ARW-681	600
150	Cr.-Wh.	SC-140	3600
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5815	1200

M.G. SETS

Kilowatt	Make	Volts AC	Volts DC
1000	West.	4000	230
750	G.E.	4160	275
500	West.	440	250
400	Al. Ch.	2300	240
300	West.	2300	250
200	G.E.	2300	275
200	Rdwy	2300	250
150	Al. Ch.	2300	275
150	West.	2300	250
125	Cr. Wh.	4160	125
125	G.E.	2300	250
100	G.E.	2300	250
100	Al. Ch.	2300	250
60	G.E.	220/440	250
40	G.E.	220/440	250

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H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200
1000	*West.	CW	450
600	*G.E.	M-6843-S	1800
500	G.E.	M-6845	1200
400	*G.E.	MTP-585	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh.	SR-70-R	1800
250	Al.-Ch.	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	800
200	*West.	CW1950A	514
150	Cr-Wh.	SR-50R	1800
150	G.E.	I-M-15A	900
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200

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A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT-6	6600	1187
1	800	Whse.	CW	550	1776
1	600	Whse.	CW-432D-15	440	1778
1	600	Whse.	CW	550	350
1	500	Whse.	CW	550	350
1	300	G.E.	MTP-561	2300	1800
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
1	250	Whse.	CW-1010	2200	433
1	200	G.E.	IM	2200	580
1	200	G.E.	IM	2200	435
1	200	G.E.	CW-890	2300	1775
2	200	Whse.			

SQUIRREL CAGE

2	550	Whse.	CS-1115	2300	900
1	500	G.E.	FT-559AY	2300	3600
4	500	Whse.	CS-1216	2200	500
3	500	G.E.	KP	2300	3600
2	450	Elliott	3910BB	2300	1200
2	400	Whse.	CS	6600/4000	3565
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-903H	2300	1175/878
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CS-8558	220/440	1750

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	3500	G.E.	TS-6438P	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1200	West.	720	600	2300/4160
1	1000	G.E.	900	260	6600
1	500	G.E.	900	250	2300/4600
1	500	G.E.	900	125/250	440
1	350	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	200	Whse.	1200	600	2300
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	El. Mhy.	1200	250	2300/4600

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	300	G.E.	175/200# Cond. 480/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	PYR.	1	55/255
2	500	Kuhl.	OISC	1	13200x6600
6	333	G.E.	OISC	1	7200/12470Yx2400/4160Y

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300

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1—B&W 90,000#s, 263 psi, 500 degrees
2—B&W 85,000#s, 250 psi, 500 degrees
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3—C-E 50,000#s, 200 psi
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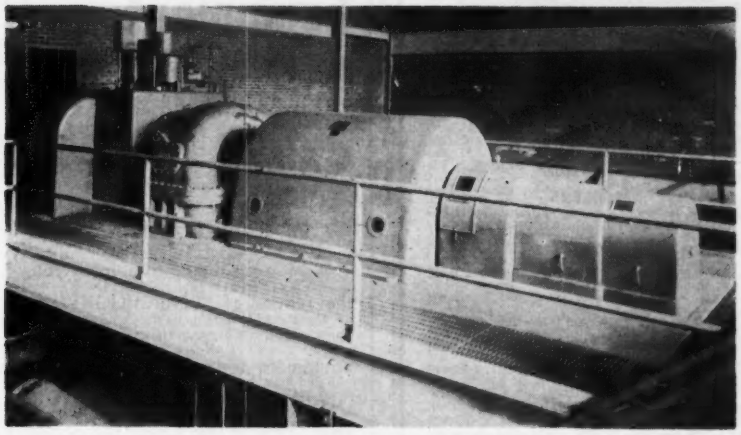

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1—7500 KW West. 400# 750° Cond. 4160V.
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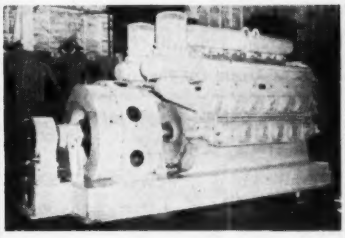

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1—1075 FCM Worthington Type DYC, Vertical Angle Duplex Size 16x16x14½x9½ Serial L61565 New 1954. Max Pres. 125#, 350 H.P. 3/60/2300 Volt, 450 RPM, control, spares.

1—1100 C.F.M. Ing. Rand XPV, 18x11x14 Steam Drive (1948) 100 psi

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1—375 KVA—G.M. 8-268—3/60/480 1200 RPM—Diesel

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1—156 KVA Cummins Diesel 3/60/240 Rad. Cooled —New 1956—Never Used

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3—333 KVA Penna. 7200-480/240
3—250 KVA & G.E. 2400-240/480

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1—200 H.P. Titusville—Iron Fireman Automatic Scotch Package 150 psi—Hy Oil—Brand New —Immed. Shipment.
1—150 H.P. Cleaver Brooks LF15, 150#, 1947. #5 oil, control 3/60/220 Volt.
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1—125 H.P. Cleaver-Brooks 125#, 1946 Model OB rotary—control 3/60/220
1—100 H.P. Clayton 150 lb. 1950—light oil 3/60/220 Volt.
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1—50 H.P. Clayton 150 lb. 1950. #2 oil. 3/60/220 Volt.
#5 oil, control 3/60/220 Volt.
1—125 H.P. Cleaver Brooks 150# 1947, #5 oil

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NEW — UNUSED

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1250 K.W.—450 volts—3 phase—60 cycle—80% P.F.—1200 R.P.M. with 10 K.W. on a 120 volt D.C. exciter.

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540 lbs. per sq. inch gauge with 825° T.T. and one lb. per sq. inch absolute exhaust pressure. It will develop rated capacity with steam conditions of 432 lbs. per sq. inch—825° T.T. and one lb. per sq. inch exhaust pressure. Turbine R.P.M. 8050. The turbine exhausts into an auxiliary condenser.

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184 CFM 135 psi 8x8 Ing. ES
191 CFM 300 psi 9-4½x9 Ing-ES-2
238 CFM 100 psi 9x9 Worth. H. B. Ing. ES
242 CFM 125 psi 8x7 Joy WG9
286 CFM 500 psi 10-4½x10 Ing.
311 CFM 1500 psi 10½-7½-3½x18 Ing. ES3
321 CFM 125 psi 10x11 Ing ES
486 CFM 100 psi 12x11 Ing.
502 CFM 125 psi 12x18 Worth HB
585 CFM 100 psi 15-9½x12 Ing. XRE
628 CFM 100 psi 14x15 Ing ES
676 CFM 100 psi 15-9½x12 Ing. XRB
1545 CFM 110 psi 21-13x14 Ing. XRE
920 CFM 110 psi 16-11x12 CP-OCE
7960 CFM 250 psi 33-17¾x27 IR PRE2 4C

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88000	delta	8825	delta
77000	wye	5750	wye
44000	delta	4315	delta
38500	wye		
22000	delta		

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2000 KW, GE N.C. Ext. Turbo-Gen. 480V, 600#, 650°, 150# Ext, 30#BP

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150 KW General Motors Diesel Units 3/60 220/440V 1800 RPM—(3)

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500	G.E. S.B. Open	IK	1200
400	G.E. S.B. Open	IK-17B	900
400	L.A. B.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	West. S.B. Open	CS	900
400	West. S.B. Splash 2800 Volt	CS-398	720
300	G.E. S.B. Open	IK	600
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	El. Dyn. T.E.F.C.B.B.	KNX	1800
250	G.E. S.B. Open	KT	1800
250	G.E. S.B. Open 2200 Volt	IK-18	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	Cont. T.E.F.C.B.B.	NP-686C	1800
200	West S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	Al. Chal. B.B. Open		900
200	West. S.S.B. Open	CS-878	900
200	G.E. S.B. Open	IK	900
150	L.A. TEFCBB	JX-114	3600
150	West. S.S.B. Open	CS-781C	1800
150	Al. Chal. B.B. Open	AR	1800
150	West. S.B. Open 2200V	CS	1800
150	G.E. S.B. Open	IK	1800
150	G.E. B.B. Open	KT	1200
150	F.M. B.B. Open	H-24A	900
150	G.E. S.B. Open	IK	900
150	Cont T.E.F.C. B.B. New		900
150	G.E. S.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	Cont. TEFCBB XP	AP-109	1800
125	Burke B.B. Open 440 Volt	N-505	3600
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	West TEFCBBCS	855	1200
125	Al. Chal. B.B. Open	AR	1800
125	G.E. S.B. Open	KT-533	1200
125	G.E. S.B. Open	IK	1200
125	F.M. B.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
125	West B.B. Open	CS874C	600
100	Howell T.E.F.C.B.B.	K-505	3600
100	Cont. TEFCBB XP	AP-505	1800
100	West. T.E.F.C. B.B.	CS-753	1800
100	G.E. S.B. Open	KT-343	1800
100	G.E. B.B. Open	K-504	1800
100	LA. T.E.F.C.B.B.	JX-113	1800
100	West. TEFCBB	CS-770	1200
100	G.E. S.B. Open	KT-347	1200
100	West. SSB Open	CS-807	1200
100	F.M. B.B. Open	H-202	900
100	F.M. B.B. Open	H	720
75	Reliance B.B. Splash	505	1200
75	Al. Chal. TEFCBB	ARZ	1200
75	G.E. B.B. Open	KT-547	1200

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150 HP G.E. 900 TEFC 440V
150 HP West. Type CW 1800 Slip Ring 440V
75 HP West. Type CW 1800 Slip Ring 440V (2)
50 HP G.E. 1800/900 X.P. 440V TEFC (2)
50 HP Allis Chalmers 1800, 440V
40 HP G.E. 3600 D.P. Vert. Hollow Shaft (5)
30 HP G.E. 3600 D.P. Vert. Hollow Shaft (2)
30 HP West. Type CW 1200 Slip Ring 440V

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Advertisers' Index

A

ACF Industries, Inc. W-K-M Division 48
Aerotec Industries, Inc. ..... •
Air Preheater Corp. 131
Allen-Sherman-Hoff Co. ..... •
Allgemeine Elektricitats-Gesellschaft ..... Second Cover
Allis-Chalmers Mfg. Co. 139, 141
Allis-Chalmers Mfg. Co. Hydraulic Div. ..... •
Allpax Company, Inc. ..... •
Alpha-Molykote Corp. ..... •
American Brass Co. ..... •
American Engineering Co. ..... •
American Gilsonite 212
American Hard Rubber Co. 90
American Meter Co., Pump Div. ..... •
American Pulverizer Co. 104
American Standard, Industrial Div. ..... •
Ames Iron Works ..... •
Anchor Packing Co. 117
Annin Company ..... •
Armstrong Machine Works 81
Asea Electric, Inc. 116
Atomics International Div. of North American Aviation 133

B

B-I-F Industries, Inc. 102
Babbitt Steam Specialty Co. 172
Babcock & Wilcox Co. Boiler Div. 6-7
Babcock & Wilcox Co. Tubular Products Div. ..... •
Babcock & Wilcox Co. Tubular Products Div., Fittings Dept. ..... •
Badger Mfg. Co. ..... •
Bailey Meter Company 10-11
Baldwin-Hill Co. ..... •
Baltimore & Ohio Railroad ..... •
Barnes & Jones, Inc. ..... •
Basnik Co., Vince 140
Belmont Packing & Rubber Co. 158
Biddle Co., James G. ..... •
Bingham Pump Co. 105
Bituminous Coal Institute ..... •
Black, Sivalls & Bryson, Inc. ..... •
Blaw-Knox Company Equipment Div. 144
Blaw-Knox Company Power Piping Div. 85
Boiler Engineering & Supply Co. ..... •
Boiler Tube Co. of America ..... •
Bonney Forge & Tool Works ..... •
Borg-Warner Mechanical Seals Div. of Borg-Warner Corp. 130
Bridgeport Brass Co. 32
Brown Boveri Corp. ..... •
Buell Engineering Co. 128
Buensod-Stacey Co. ..... •
Buffalo Forge Co. ..... Third Cover
Buffalo Pumps Div. of Buffalo Forge Co. ..... •
Bussman Mfg. Div. McGraw-Edison Co. 50-51
Butler Mfg. Company 173

C

Capitol Pipe & Steel Products, Inc. 123
Carling Turbine Blower Co. ..... •
Carpenter Steel Co. Alloy Tube Div. ..... •
Catawissa Valve & Fittings Co. ..... •
Chase Brass & Copper Co. ..... •
Chemtrol 150
Chesterton Co., A. W. ..... •
Chicago Pneumatic Tool Co. 14-15
Childers Mfg. Co. ..... •
Clarage Fan Co. 179
Clark Bros. Co. One of the Dresser Industries ..... •
Cleaver-Brooks Co., Boiler Div. 92
Cochrane Corporation ..... •
Coen Company 114
Coffin Turbo Pump Co. ..... •
Combustion Engineering, Inc. 40-41
Condenser Service & Engrg. Co. ..... •
Cooper-Bessemer Corp. 20-21
Copes-Vulcan Div., Blaw-Knox Company 12-13
Coppus Engineering Corp. 103
Corning Glass Works ..... •
Crane Company 109
Crane Packing Co. 120
Crawford Fitting Co. 169

D

Daystrom Systems Div. of Daystrom, Inc. ..... •
DeLaval Steam Turbine Co. 38-39
Detroit Controls Div. of American Standard ..... •
Detroit Stoker Co. 143
Diamond Power Specialty Corp. 6-7, 93
Dodge Mfg. Corp. 33
Dow Chemical Co. ..... •
Dow Corning Corp. ..... •
Dowell ..... •

E

Eagle-Picher Co. 142
Edward Valves, Inc. 42-43
Electrama ..... •
Electric Machinery Mfg. Co. 26-27
Elgin Softener Corp. ..... •
Elliott Company ..... •
Elliott Company—Lagonda Plant ..... •
Elliott Company—Roto Plant ..... •
Emhart Mfg. Company Maxim Div. 166
Engineer Company ..... •
Erie City Iron Works 34-35

F

Fairbanks Company ..... •
Fiber Glass Div. 203
Fibreboard Paper Products Corp. Pabco Ind. Insulations Div. ..... •
Fisher Governor Co. 18-19
Flexitallic Gasket Co. 107
Fly Ash Arrestor Corp. 132
Foster Company, Benjamin 96
Foster Wheeler Corp. 44-45
Foxboro Company 91
Frick Company 88
Fuller Company 84
Fybrglas Industries 202

G

Garlock Packing Company 153
General Controls Corp. ..... •
General Electric Co. 16-17
Goulds Pumps, Inc. ..... •
Green Fuel Economizer Co. 121
Grinnell Company ..... •
Griscom-Russell Co. ..... •

H

Hagan Chemical & Controls, Inc. 174
Hall Laboratories ..... •
Hamon, Inc. 181
Harbison-Walker Refractories Co. ..... •
Heyl & Patterson, Inc. ..... •
Hooper Printing & Lithograph Co. 124
Hungerford & Terry, Inc. 150
Hupp Aviation Company Electrodyne Div. ..... •

I

I-T-E Circuit Breaker Co. ..... •
Illinois Water Treatment Co. ..... •
Infilco, Inc. 46
Ingersoll-Rand Co. 147
International Boiler Works Co. ..... •
International Nickel Co., Inc. 52
International Register Co. Instrument Div. ..... •
Iron Fireman Mfg. Co. ..... •

J

Jenkins Bros. 83
Jerguson Gage & Valve Co. 124
Johns-Manville ..... •
Johnson Service Co. 28-29

K

Kato Engineering Co. ..... •
Keasbey & Mattison Co. 163
Keeler Co., E. ..... •
Kennedy Valve Mfg. Co. 160
Kennedy-Van Saun Mfg. & Engrg. Corp. 180
Kerrigan Iron Works Co. ..... •
Kieley & Mueller, Inc. 145
Kinney Engineers, Inc., S. P. 140
Kirk & Blum Mfg. Co. ..... •
Klipfel Valves, Inc. ..... •
Koppers Co., Inc. Coupling Dept. ..... •
Koppers Co., Inc. Electrostatic Precipitators 167

L

Laclede Stoker Co. ..... •
Leslie Company 22-23
Limitorque Corp. ..... •
Link-Belt Company 1
Liquidometer Corp. ..... •
Lunkenheimer Company ..... •

M

Manning, Maxwell & Moore ..... •
Marley Company 115
Marsh Corp., Jas. P. ..... •
Mason-Neilan Div. of Worthington Corp. ..... •
McDonnell & Miller, Inc. 122
McGraw-Hill Book Co. ..... •
McNally Pittsburg Mfg. Corp. 168
Mercoid Corp. 172
Midwest Piping Co., Inc. ..... •
Minneapolis-Honeywell 161
Monsanto Chemical Co. Organic Chemical Div. ..... •
Murray Iron Works Co. 94
Murray Mfg. Co., D. J. 126

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

N

Nalco Chemical Co. ... 127
National Airoil Burner Co., Inc. ... *
National Conveyors Co., Inc. ... *
National Electric Coil ... 182
National Tube Div. of U. S. Steel ... *
Niagara Blower Co. ... *
Nicholson & Co., W. H. ... *
Nordberg Mfg. Co. ... 175
Norfolk & Western Railway ... *

O

Ohio Brass Company ... *

P

Panellit, Inc. ... *
Patterson-Kelley Co. ... *
Peabody Engineering Corp. ... *
Peerless Pump Div., Food Machy. & Chemical Corp. ... *
Pennsylvania Pump & Compressor Co. ... *
Pfaudler Permutit, Inc. ... 152
Pfizer Co., Charles ... *
Phelps-Dodge Copper Products Corp. ... 36-37
Philadelphia Gear Corp. ... *
Phoenix Mfg. Co. ... *
Pioneer Service & Engrg. Co. ... *
Pipe Fabrication Institute ... *
Pittsburgh Piping & Equipment Co. ... *
Porter Co., Inc., H. K. Forge & Porter Fittings Div. ... 162
Powell Co., Wm. ... 95
Pratt Co., Henry ... 170
Pritchard & Co., J. F. ... *

R

R-P & C Valve Div., Amer. Chain & Cable Co., Inc. ... 164
Raybestos-Manhattan, Inc. Manhattan Rubber Div. ... *
Raybestos-Manhattan, Inc. Packing Div. ... *
Reliance Gauge Column Co. ... *
Republic Flow Meters Co. ... 24-25
Republic Steel Corp. Steel & Tubes Div. ... 154-155
Research-Cottrell, Inc. ... 30-31
Ridge Tool Company ... 113
Riley Stoker Corporation ... 74-75
Robertshaw-Fulton Controls Co. Aeronautical & Instruments Div. ... 126
Rockwell Mfg. Co. Nordstrom Valve Div. ... 89
Rohm & Haas Co. ... 135

S

Sarco Company, Inc. ... *
Schaub Engineering Co., Fred H. ... 106
Schoonmaker Co., Inc., A. G. ... *
Scovill Mfg. Co. ... *
Smith Corp., A. O. ... *
Socony Mobil Oil Co. ... *
Spence Engineering Co. ... 47
Standard Oil Co. of Indiana ... 77
Stephens-Adamson Mfg. Co. ... *
Stickle Steam Specialties Co. ... *
Strong, Carlisle & Hammond ... *
Superior Combustion Industries, Inc. ... 101

T

Terry Steam Turbine Co. ... 165
Texaco, Inc. ... *
Titusville Iron Works Co. Div. of Struthers-Wells ... 125
Todd Shipyards Corp. Products Div. ... 140

U

Union Asbestos & Rubber Co. ... *
Union Iron Works ... *
U. S. Electrical Motors, Inc. ... *
United States Gauge ... 171
United States Motors Corp. ... *
Universal Atlas Cement Div. of U. S. Steel ... *

V

Viking Pump Co. ... *
Virginia Gear & Machine Corp. ... *
Vogt Machine Co., Henry ... 119

W

Wallace & Tiernan, Inc. ... 118
Walworth Company ... 134
Western Chemical Co. ... *
Western Precipitation Corp. ... 159
Westinghouse Electric Corp. ... 151
Wheeler Mfg. Co., C. H. ... *
Where to Buy ... 202
Whiton Machine Co. ... *
Wickes Boiler Co. ... *
Wiedeke Co., Gustav ... *
Wolverine Tube Div. of Calumet & Hecla, Inc. ... 129
Worthington Corp. ... Back Cover

Y

Yarnall-Waring Company ... 8-9, 148, 149

Z

Zallea Brothers ... 79
Ziegler Co., G. S. ... *
Zimmerman Packing Co. ... 124

•

Professional Services ... **202**

•

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES ... 203

EQUIPMENT
(Used or Surplus New) For Sale ... 203-209

WANTED
Equipment ... 203

ADVERTISERS INDEX

Ajax Electric Motor Corp. ... 203
Allied Electric & Machinery Co. ... 205
American Air Compressor Corp. ... 208

Belyea Co., Inc. ... 204, 206
Benson-Wilimzig Inc. ... 204
Boston Metals Co. ... 205, 208
Brew-Woltman & Co., Inc. ... 209
Brill Equipment Co. ... 206

Campbell & Co., Ltd., C. R. ... 207
Chicago Electric Co. ... 206

Davis, Samuel M. ... 204
DeRose, G. M. ... 206

Electric Equipment & Engineering Co. ... 205
Erie Electric Co., Inc. ... 203
Estes Machinery Co. ... 203
Euclid Eng. Corp. ... 207

Foster Co., L. B. ... 204

Hall & Co., Stephen ... 204
Harris Machinery Co. ... 203
Heat & Power Co., Inc. ... 209
Hemphill & Co., J. L. ... 204
H & P Machinery Co. ... 204

Industrial Engineering Associates ... 203, 207
International Power Machinery Co. ... 203, 209

Land Inc., L. J. ... 208
Long Island Lighting Co. ... 203

Midwest Boiler & Turbine Co. ... 206

O'Brien Machinery Co., The ... 208

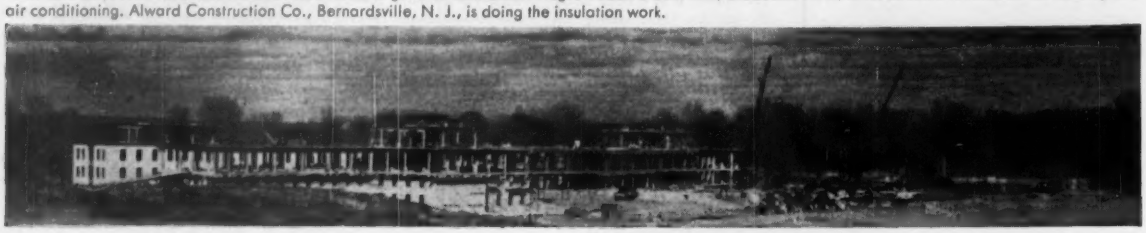
Pelnick-Loconti Industrial Supply Co. ... 204
Perry Equipment Corp. ... 208
Philadelphia Transformer Co. ... 203
Power Equipment Co. ... 209

Schoonmaker Co., Inc. ... 207, 209

Universal Power Engineering Co. ... 203
Upjohn Co., The ... 203
Utilities Machinery Co. ... 207

Wabash Power Equipment Co. ... 204
Wagner Co., Arthur ... 206
Weaver Inc., Charles ... 207
Whisler Equipment Co. ... 204

The Esso Research Center's 3-story, 600-ft.-long office building includes conference rooms, technical library, correlations and computor center, medical department, cafeteria and landscaped court for its 800 employees. The project was designed and engineered by Voorhees Walker Smith Smith and Haines of New York City. Frank Briscoe, Inc., Newark N. J., is general contractor. August Arace & Son, Inc., Elizabeth, N. J., is mechanical contractor for heating and air conditioning. Alward Construction Co., Bernardsville, N. J., is doing the insulation work.



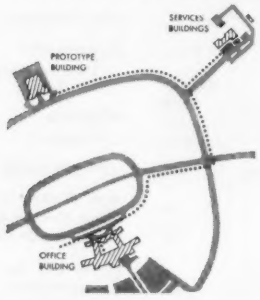
Esso Research Center uses GILSULATE® for insulating mile of underground steam pipes

GILSULATE goes in fast. In the foreground the field inspector checks depth of pour. Directly in back of him, two workmen are shovelpointing and tamping. Other workers are sliding GILSULATE bags into pipe trench while men at rear are placing plywood forms near manhole.

Esso Research and Engineering Company, the scientific and engineering affiliate of Standard Oil Company of New Jersey, is now constructing a modern research center in Florham Park, N. J. To preserve the natural beauty of the 675-acre site, all heating, air conditioning, power and communications lines are run underground.

Steam, at a pressure of 250 lbs. (406°F.), will flow through a 600-ft.-long, 12" welded steel pipe from the boiler room to a manhole where a 1400-ft. string of 10", 8" and 6" pipe will carry heat to the prototype building. Similar piping leaves the other side of the first manhole and runs 2500 feet to the main office building. Trenches also carry 3" to 6" condensate return lines. The system has 24 expansion loops and seven manholes, and includes capped lines for use when facilities are expanded.

Over 500 tons of GILSULATE will be used for insulating and protecting the underground steam pipes. In addition to its low thermal conductivity, GILSULATE resists attack by acids, alkalies and electrical conductivity and provides excellent protection against corrosion. For full information on this low-cost, poured-in-place insulation, see your local GILSULATE distributor, or write our Salt Lake City office.



FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour, shovelpoint and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by buried hot pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS:** no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING:** for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220-300° F. temp. range
   Type B for 300-385° F. temp. range
   Type C for 385-520° F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF UNDERGROUND HOT PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY

Affiliate of Barber Oil Corp. & Standard Oil Co. of California
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3537 Lee Road, Cleveland 20, Ohio
Distributors in Principal Countries of the World

Do you receive Pipe Insulation News? Ask to be put on our mailing list.

For more facts circle 323 on Reader Service card, p 97

WHEN FIRST COST IS IMPORTANT "BUFFALO" RADIAL WHEEL FANS

"Buffalo" Type "CR" Radial Wheel Fan

"Buffalo" Radial Wheel Fans combine the low cost advantages of this type design with the highest efficiencies possible with a radial blade wheel. This is a great advantage in applications suited to this fan. These include stoker-fired or pulverized coal boilers. The "CR" is also widely used for handling air with dust loadings in many industrial jobs.

The "CR" combines sharply rising pressure and horsepower characteristics with high static efficiency. Ruggedly-built, it gives long, trouble-free performance under severe conditions. The high pressure and capacity of this fan often permit use of a smaller unit for many direct-connected applications. This results in further first cost savings.

For dependable, stable radial wheel fan performance, investigate the "Buffalo" Type "CR" Fan. It's designed for both constant volume or inlet-dampered operation. Write for full information in Bulletin FD-205.

"Buffalo" manufactures a complete line of Mechanical Draft Fans. Included are airfoil and backward-curved designs, with a broad choice of wheels. For details on the full line, call your nearby "Buffalo" engineering representative. Or write us direct for Bulletin FD-905.

BUFFALO FORGE COMPANY

Buffalo, N. Y.

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

For more facts circle 202 on Reader Service card, p 97

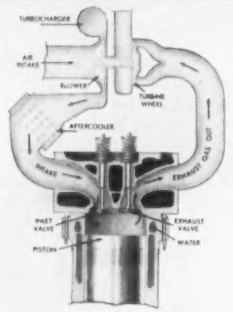
How much do you know about

TURBOCHARGING AN ENGINE?

An interview with William M. Kauffmann, Chief Engineer of the Engine Division, Worthington Corporation. Turbocharging of high-output engines is an accomplished fact. Last year *100%* of all power engines built by Worthington were equipped with turbochargers. In this short interview Mr. Kauffmann outlines some of the design philosophy behind turbocharging. If you would like to have more information about Worthington's line of turbocharged engines and engine compressors, won't you write to Worthington Corporation, Section 43-7, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

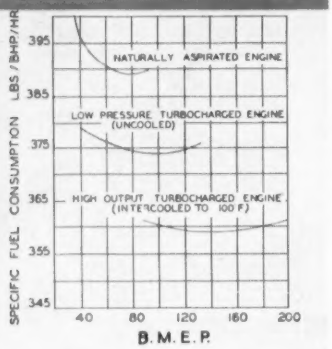
WORTHINGTON

Q. WHAT DESIGN PRINCIPLES ARE INVOLVED IN HIGH-OUTPUT TURBOCHARGING?



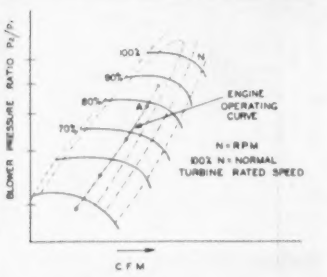
A. The method I favor uses design principles that produce optimum mechanical and thermal operating efficiency. For example, four-valve head design gives higher volumetric efficiency; thru-flow scavenging results in increased cool air flow through the cylinder; flood cooled pistons reduce ring belt temperature; dry exhaust manifold lowers heat rejection to cooling system; air aftercooling reduces initial cycle temperature and thermal load; high pressure turbochargers give high air excess at moderate charging pressures due to improved combined efficiencies of gas turbine and blower; fixed valve overlap assures best scavenge ratio and increased trapped air volume; high velocity jacket water cooling reduces liner temperature.

Q. HOW MUCH IMPROVEMENT HAS TURBOCHARGING MADE IN FUEL ECONOMY?



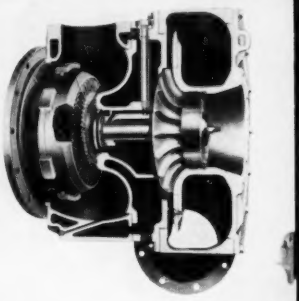
A. Paradoxically, modern high-output Diesels exhibit far better fuel consumption than older, low pressure charged units. Fuel consumptions of .360 lbs./bhp/hr. or lower, on fuel oil, and 6250 Btu/bhp/hr. or under, on dual fuel or spark ignition operation are not unusual. This makes thermal efficiencies of 40% or over, available to power users. Result: additional first cost economy for heat exchanger equipment and auxiliary sizes, plus the better plant economy.

Q. ARE SEA LEVEL RATINGS AT ALTITUDE POSSIBLE?



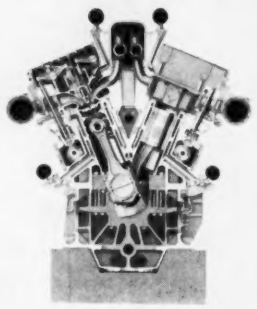
A. Reduced barometric pressure at altitude increases available gas turbine power, thus allowing packing as much air into the engine as at sea level. Turbochargers with blower pressure ratios up to 3.0, make possible sea level ratings at altitudes up to 8000 ft. Turboblower discharge air aftercooling gives these engines low mean cycle temperatures consistent with sea level operation. Benefit: less floor space and building size than for previously derated units. Such units have given exceptionally reliable service, matching sea level overload performance.

Q. HOW ABOUT TURBOCHARGER MAINTENANCE AND RELIABILITY?



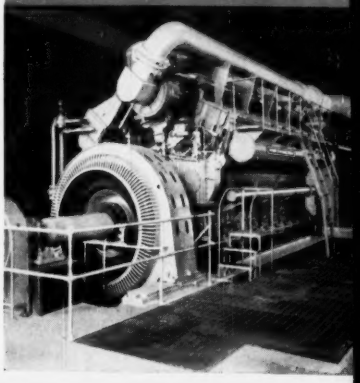
A. An integrated turbolubricating system permits using proper lubricant for the turbocharger. A separate sump, full-flow filter and pump provide complete rotating element protection for long life with only periodic inspection. These turbochargers are of rugged design and are thoroughly field proven. Normal full load speed is conservative, usually not exceeding 80% of supplier maximum recommendation.

Q. WHAT ABOUT TURBOCHARGING A GAS ENGINE?



A. The first turbocharged gas burning diesel was conceived by Worthington's engineers in 1943, and demonstrated to the public early in 1945. This design used low pressure gas, admitted into the air inlet passage, and represented a new concept for gas operation. Air-fuel ratio control developments (Worthington's "Turbomizer") for spark ignition engines, followed. Since many basic dual fuel and spark ignition engine components were interchangeable, the Tri-Power engine was the next logical step. This gives turbocharged diesel oil, dual fuel gas, or spark ignition gas engine operating with the same unit, allowing use of most economical fuels.

Q. IS TURBOCOOLING NECESSARY?



A. Large bore, slow speed, gas engines suffer from low knock limit due to small cooling area per unit cylinder volume. Here, extreme measures to cool the air are necessary, although possibly complex and costly for moderate ratings. High cylinder surface-to-volume ratio engines (such as Worthington's SW14) exhibit high knock limit and will operate at high bmep with only normal aftercooling. This means simpler construction and operation.

For more facts circle 203 on Reader Service card, p 97